Tupolev Tu-16 *Badger*

Versatile Soviet Long-Range Bomber

Yefim Gordon and Vladimir Rigmant

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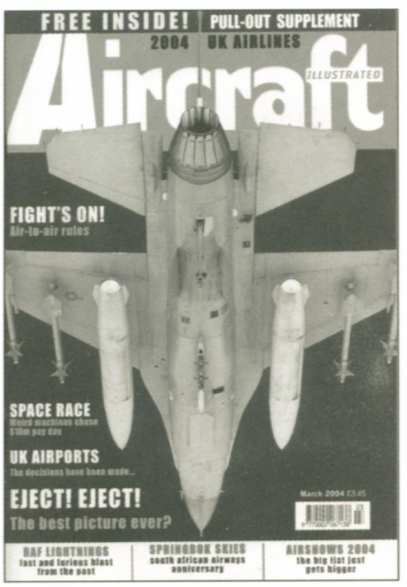

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AeroFax
An imprint of
Ian Allan Publishing

Tupolev Tu-16:
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© 2004 Yefim Gordon and Vladimir Rigmant

ISBN 1 85780 177 6

Published by Midland Publishing
4 Watling Drive, Hinckley, LE10 3EY, England
Tel: 01455 254 490 Fax: 01455 254 495
E-mail: midlandbooks@compuserve.com

Midland Publishing and Aerofax are imprints of
Ian Allan Publishing Ltd

Worldwide distribution (except North America):
Midland Counties Publications
4 Watling Drive, Hinckley, LE10 3EY, England
Telephone: 01455 254 450 Fax: 01455 233 737
E-mail: midlandbooks@compuserve.com
www.midlandcountiessuperstore.com

North American trade distribution:
Specialty Press Publishers & Wholesalers Inc.
39966 Grand Avenue, North Branch, MN 55056
Tel: 651 277 1400 Fax: 651 277 1203
Toll free telephone: 800 895 4585
www.specialtypress.com

Original translation by Alexander Boyd
Edited by Dmitriy Komissarov
Line drawings by Vladimir Klimov
and Andrey Sal'nikov

Design concept and layout
© 2004 Midland Publishing and
Sue Bushell

Printed in England by
Ian Allan Printing Ltd
Riverdene Business Park, Molesey Road,
Hersham, Surrey, KT12 4RG

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The Tu-16 in Colour. 145

Title page: **A pair of Tu-16K-10s is serviced in an earthen revetment at a Soviet Navy airbase. Note the concrete blast deflector behind the aircraft in the background.** Yefim Gordon archive

Below: **Winter scene at a DA airbase as Tu-16A '35 Red' (c/n 6203101) is prepared for a night sortie on a floodlit hardstand.**
Yefim Gordon archive

Introduction

The second half of the 1940s found the aircraft industries of the major world powers, the Soviet Union included, faced with the task of producing long-range bombers powered by turbojet and turboprop engines able to fly at cruising speeds close to Mach 1 while retaining the load-carrying and range capabilities of aircraft like the American Boeing B-29 Stratofortress or its Soviet analogue, the Tupolev Tu-4.

This necessity was dictated not only by the overall thrust of progress in aviation technology (the availability of gas-turbine engines and advancements in aerodynamics), the increased potential of fighter aviation (the wide-scale introduction of jet fighters capable of speeds around 1,000km/h) and air defence systems with long-range detection radars, but also by a new weapon – the atom bomb – which enabled a comparatively small number of bombers to inflict catastrophic damage on an enemy.

The United States was the first to produce a long-range bomber powered by gas-turbine engines. The Boeing B-47 Stratojet, on which work was initiated in 1945, made its first flight in 1947 and achieved initial operational capability (IOC) with the US Strategic Air Command in the early 1950s as a 'medium-range strategic bomber'. It was followed by Great Britain with its trio of V-Bombers – the Vickers Valiant, Avro Vulcan and Handley Page Victor – also medium-range strategic bombers, which served for many years as the basis for the British nuclear deterrent.

For the USSR the production of a long-range bomber with an operational radius up to 3,000km was vitally important. Such an aircraft would form an effective counter, able to strike at American military bases in Europe and Asia, the political, economic and military centres of America's allies, and American and British naval concentrations, particularly aircraft carriers which presented a particular threat to the USSR. It would also be capable of attacking the transatlantic supply routes, without which the ability of America's European allies to fight a protracted defensive war against the USSR would be highly problematical.

These naval and maritime considerations were, it should be said, crucial for the USSR in developing its long-range bombers and then, from the late 1950s, equipping them to carry air-to-surface missiles. The need to counter the West's enormous naval superiority, both in size and expertise, demanded the development of a class of aircraft able to operate effectively against the surface vessels of a potential enemy over the expanse of the world's oceans. It is for this reason that the USSR, and the Russia of today, has constantly produced and developed this particular type of aircraft – a long-range bomber equipped with air-to-surface missiles – while its potential enemies in the West have not. From the 1950s through the 1980s the Soviet Long-Range Air Force and Naval Air Forces were equipped with a steady succession of such aircraft (Tu-16, Tu-22, Tu-22M), one of whose basic applications was against naval targets, particularly aircraft carriers with their formidable anti-aircraft defences.

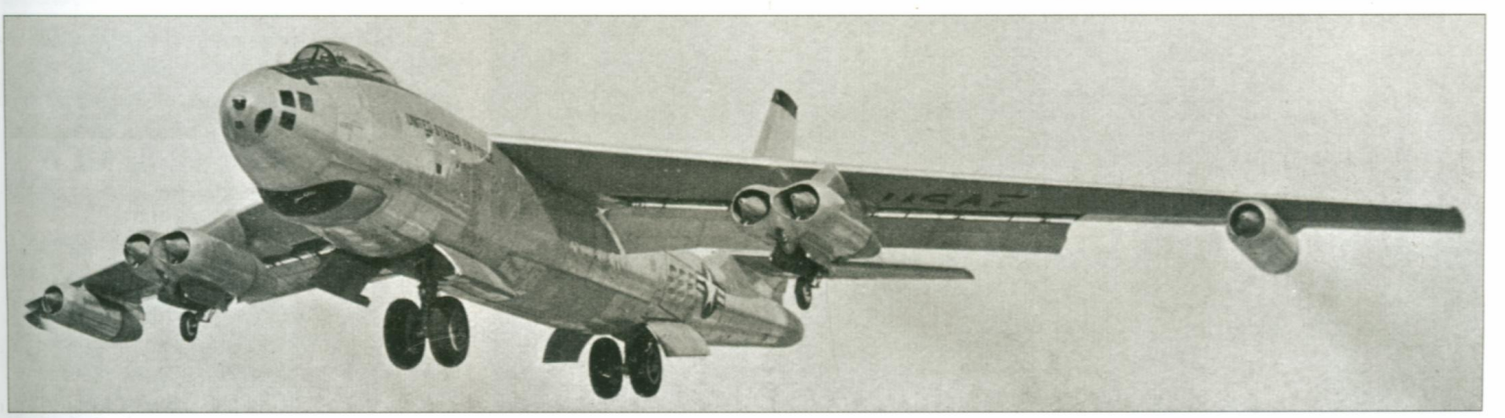
In the West the category of medium-range strategic bombers and air-to-surface missile carriers gradually died out: the B-47 was retired in the 1960s, the handful of Convair B-58 Hustler supersonic bombers were quickly withdrawn due to technical and design failings and replaced by a limited number of General Dynamics FB-111As developed from the F-111 tactical fighter-bomber – but even these inadequately fulfilled the role of the extinct medium-range bomber, and currently all of them have been reconverted back to their original role. The British V-bombers were soon withdrawn due to design faults like the Valiant or reborn, until recently retired from service, as in-flight refuelling tankers like the Victor and Vulcan. The French Mirage IV nuclear bomber can, at a stretch, be classified in this way due to its comparatively small bomb load and relatively small radius of operation.

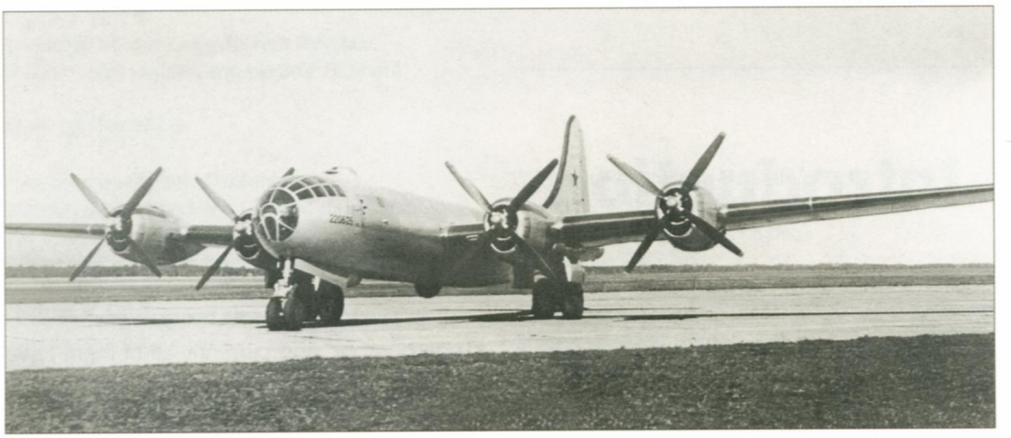
Thus the USSR remained alone among the world's major powers, designing and building aircraft in the long-range bomber category with a persistence born of its unique geopolitical and techno-military situation, endowing them with ever new roles, and making them a permanent, potent and continually updated response in the ruthless military-political game with the West now known as the Cold War. For many years one of the most prominent pieces in this game of world chess was the Soviet Tu-16 long-range bomber and its numerous modifications.

The Soviet Air Force Command began to formulate its requirements for a future long-range jet bomber immediately after the Tu-4 began to enter service. The category of long-range bomber powered by gas-turbine engines with pressurised crew positions and the following preliminary specification appeared in its planning for 1947-48:

Maximum speed at 1,000m	900km/h
Service ceiling	15,000m
Range at optimum speed with 3,000kg bomb load	6,000km
Time to reach 10,000m	10 minutes
Take-off run	1,200m
Landing run	800m
Bomb load	
normal	3,000kg
maximum	20,000kg
Crew	8

The Boeing B-47 Stratojet (illustrated here by a B-47B on take-off) was one of the aircraft that sparked the Tu-16's development.
Jane's All the World's Aircraft





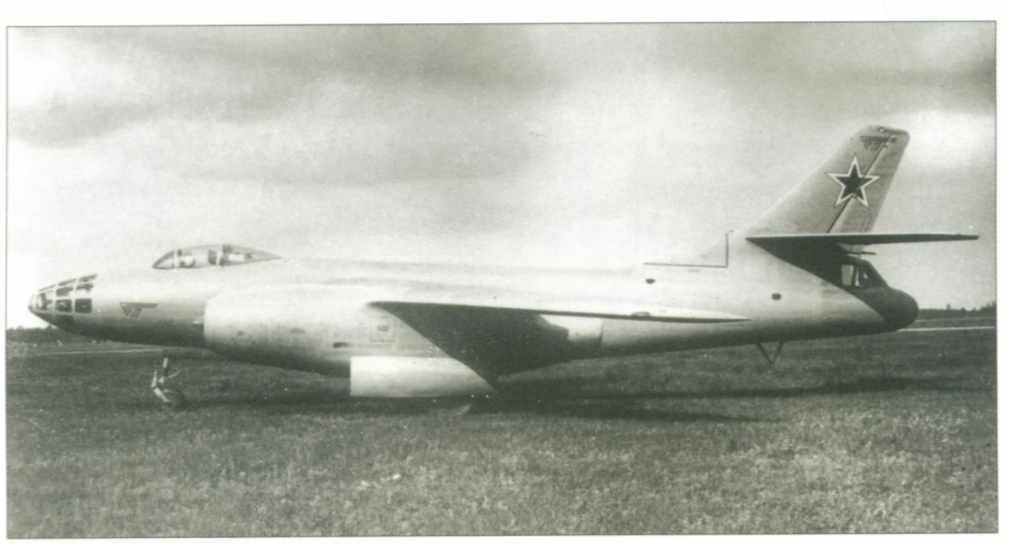
At the time when the Tu-16 came into being the piston-engined Tu-4 (illustrated by a Kazan'-built example, c/n 220605) made up the backbone of the Soviet long-range heavy bomber force. It was built at two of the three factories which later produced the Tu-16. Tupolev JSC

Two views of the '82' (Tu-82), one of the Tupolev Design Bureau's first attempts to create a viable swept-wing jet bomber. Although the '82' never progressed beyond prototype status and was rather smaller than the Tu-16, it provided design experience which proved invaluable during the development of the latter aircraft. Tupolev JSC

Defensive armament was to consist of two 20mm or 23mm cannon with 200 rounds per gun (rpg) in a remote-controlled turret firing ahead; remote-controlled upper fuselage position with two 20mm or 23mm cannon (400rpg); ventral turret as for upper fuselage position; rear gun turret comprising three 20mm or 23mm cannon (400rpg).

The bomb load was to consist of all types of bombs carried by the Tu-4, but, in addition, provision was to be made for carrying four of the new VT-1000 or TAV-1000 special bombs in the bomb bay and for delivering the forthcoming Soviet atom bomb. A variant of the aircraft was envisaged which would be able to carry a 7,000-kg air-to-surface missile.

The following essential radio navigation and targeting equipment was to be installed: radar sights for the gun positions; overall fire control radar; OPB vector-synchronised optical bomb sight (*op**tich**eskiy bombardi**rov**ochnyy pri**tsel***) linked to the autopilot and to the bombardier's panoramic radar; AP-5 autopilot; astrocompass; aircraft sextant; ARK automatic radio compass; RV-2 low-altitude radio altimeter (***rah**diovysoto**mer***); RV-10 high-altitude radio altimeter; Meridian short-range radio navigation (SHORAN) system; long-range radio navigation (LORAN) system; enemy radar detection and counter-measures equipment; identification friend-or-foe (IFF) equipment; radar warning receiver (RWR) alerting the crew of enemy fighter attacks; an 'autonavigator' (that is, navigation computer); RSB-D and RSIU-3 communications and command radio sets; SCR-578 emergency radio; recce cameras comprising two AFA-33-50 or 75 cameras (***aero**fot**oapparaht***) with plan and oblique mountings; an auxiliary power unit based on a generator driven by a petrol engine.



It is evident from these specifications for a future long-range bomber that the Soviet Air Force Command was calling for a high-speed aircraft fitted with the very latest systems and able to carry out missions in the teeth of strong enemy air defences at any time of day or night, in any weather conditions, and in a variety of theatres of operation. The early interest in the aircraft's ability to carry a large air-to-surface missile is also noteworthy.

The new bomber was to replace the obsolescent Tu-4 (the prototype B-29 had first flown in 1942) in Long-Range Aviation (the heavy bomber arm of the Soviet Air Force) service in the early 1950s. It was already obvious, however, that the chances of breaking through the ever-developing American air defence system by the early 1950s were far smaller than they would have been in 1944-45. This supposition was soon confirmed when American B-29 bombers encountered Soviet MiG-15 fighters over Korea in 1951-53, putting the further career of piston-engined long-range and intercontinental bombers at an end. The future lay with the turbojet and turboprop. In both East and West work on piston-engined bomber aircraft was being wound up – development of the Tu-85 was terminated in the USSR, and in America further production of the Convair B-36 Peacemaker was cut back – while the deployment of the American B-47 evoked the crash programme to produce the Tu-16, and accelerated work on the Boeing B-52 Stratofortress intercontinental strategic bomber in the USA and the Tu-95 and Myasishchev M-4 in the USSR.

But before a long-range bomber able to fly at transonic speeds could be created by Soviet designers, a whole series of theoretical and practical questions in the fields of aerodynamics, construction and engines had to be resolved. Without the answers, such an aircraft could not come into being.

In the second half of the 1940s the Soviet Union was able to embark on the design of sweptback wings for bomber aircraft by drawing on the creation of the first swept-wing jet fighters and the experience gained during their testing, the results of aerodynamic tests in the

This model of the '86' project shows how the future Tu-16 ('88') began to take shape. The '86' combines the underwing engine installation of its precursors with a stepped nose incorporating side-by-side seating for the two pilots. Note the chin radome and the dorsal gun barbette aft of the flightdeck. Andrey Yurgenson

A model of the projected '486' tactical bomber (that is, 1948, project No 6), showing the fighter-type cockpit for the pilot – a common feature with the '82' – and the lateral sighting blisters for the gunner operating the ventral barbette which are depressed to minimise drag. Tupolev JSC

wind tunnels at the Central Aero- & Hydrodynamics Institute named after Nikolay Ye Zhukovskiy (TsAGI – *Tsen**trahl**'nyy **a**ero- i **ghid**rodina**mich**eskiy insti**toot***) and the study of captured German material. In the process the aircraft designers had to solve a new series of problems in aerodynamics in calculating the strength of high aspect ratio swept wings, and in studying stability and control characteristics and the behaviour of swept wings at speeds near the speed of sound.

One of the first experimental design bureaux to begin work on the design of bombers with swept wings and tail assemblies was the OKB-156 design bureau (OKB = ***op**ytno-kon**strook**torskoye byu**ro***) led by Andrey Nikolayevich Tupolev. The bureau, with the aid of colleagues from TsAGI and leading specialists in the field of aircraft structural strength, designed, built and bench tested wing models with varying degrees of sweepback and rigidity. Research was undertaken into a wing with 35° sweep and an aspect ratio of between 6 and 11. The calculations for the root section of the sweptback wing posed particular problems for the structural strength specialists since, in the preferred two-spar structure, the forward spar was longer than the rear spar and carried the greater load. The distribution of stress flows in the wing centre section box and outer wing panels were studied in detail by structural specialists at TsAGI under A M Cheryomukhin, using paper models, then metal models. The test results were used to formulate an engineering methodology for sweptback wings and tail surfaces. S N Kan, I A Sverdlov and V F Kiselyov, eminent TsAGI experts on structural strength, also contributed to this research work. As a result, when the Tupolev OKB started work on designing its first swept-wing bombers it already possessed an understanding of how the wing structure would behave and a formulated methodology for its design.

The 'aircraft 82' (Tu-82), which passed its factory flight tests, was the first Soviet tactical bomber with a swept wing. It was followed by the '83', '486', '86', '87', and '491' designs which were projects only, but the cumulative experience gained enabled the OKB to go to produce the outstanding Tu-16 long-range bomber.

In the spring of 1948 the Tupolev OKB began work on an experimental swept-wing tactical bomber, known at first merely as 'aircraft 82', powered by two RD-45F or VK-1 turbojets and able to fly at speeds close to the speed of sound (Mach 0.9-0.95).

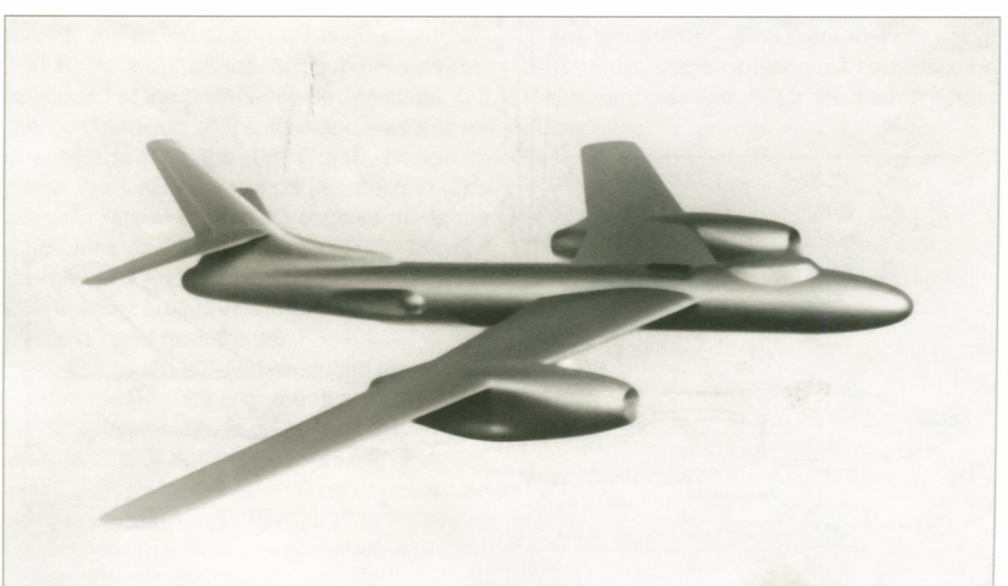
The initial project for 'aircraft 82' was a radical modification of 'aircraft 73' (a prototype version of the Tu-14 tactical bomber) with swept wings, two engines and a reduced crew of three. In this project the dorsal and ventral gun positions were deleted and replaced by a single tail position with two cannon mounted one above the other. The dimensions and flying weight were significantly reduced (wing span 17.5m, length 17m, and normal takeoff weight about 13,000kg).

On 12th June 1948 the Soviet Council of Ministers issued directive No 2052-804 concerning 'aircraft 82' which was given the official designation Tu-22. Work on the draft project, which differed only slightly from the original version of 'aircraft 82', was concluded on 22nd June 1948.

In early 1949 the '82' prototype powered by Klimov RD-45F engines was rolled out at the OKB's experimental factory (plant No 156) in Moscow and handed over for factory tests. The prototype differed from the draft project in having four pairs of wing fences, and lacked the irreversible hydraulic actuators and the rear gun position.

The '82' made its first flight on 24th March 1949 with test pilot A D Perelyot at the controls. The report on the factory flight tests noted that the bomber was stable and could be flown by a pilot with average skills. The following data was also obtained:

Normal all-up weight	14,919kg
Maximum all-up weight	18,339kg
Empty weight	11,226kg
Maximum speed	
at sea-level	870km/h
at 4,000m	931km/h
Time to reach 5,000m	5.8 minutes
Range	2,395km
Service ceiling	11,400m
Take-off run	1,100m
Landing run	550m



At the same time as the factory tests were taking place, 'aircraft 82' was being prepared to take part in the traditional flypast at Tushino. During the dress rehearsal in the summer of 1949, while the bomber was flying low over the Moskva River, it was caught in a series of thermals of varying intensity causing so-called 'recurrent turbulence' which broke the attachments of one of the engines to its nacelle. Test pilot A D Perelyot was injured when his face struck the instrument panel but managed to shut down the damaged engine and make a single-engine landing at the airfield of the Flight Research Institute named after Mikhail M Gromov (LII – ***Lyot****no-is****sled****ovatel'skiy insti****toot***) in Zhukovskiy near Moscow. This incident necessitated the introduction of the new concept of 'recurrent turbulence' – an effect arising when an aircraft flies at low altitude over terrain with a complex relief (for example, plain – river – forest) – into the structural strength calculation norms. After a series of tests, a method of allowing for 'recurrent turbulence' was introduced into the practice of aircraft design.

The prototype 'aircraft 82' was really an experimental machine for developing the concept of swept-wing design and it was not produced in series This was because The Soviet Air Force had at that time fully effected the service introduction of the Il'yushin IL-28 straight-wing tactical bomber which was already in series production. For the same reason the IL-30 bomber, a machine similar to the Tupolev '82', also remained a purely experimental aircraft.

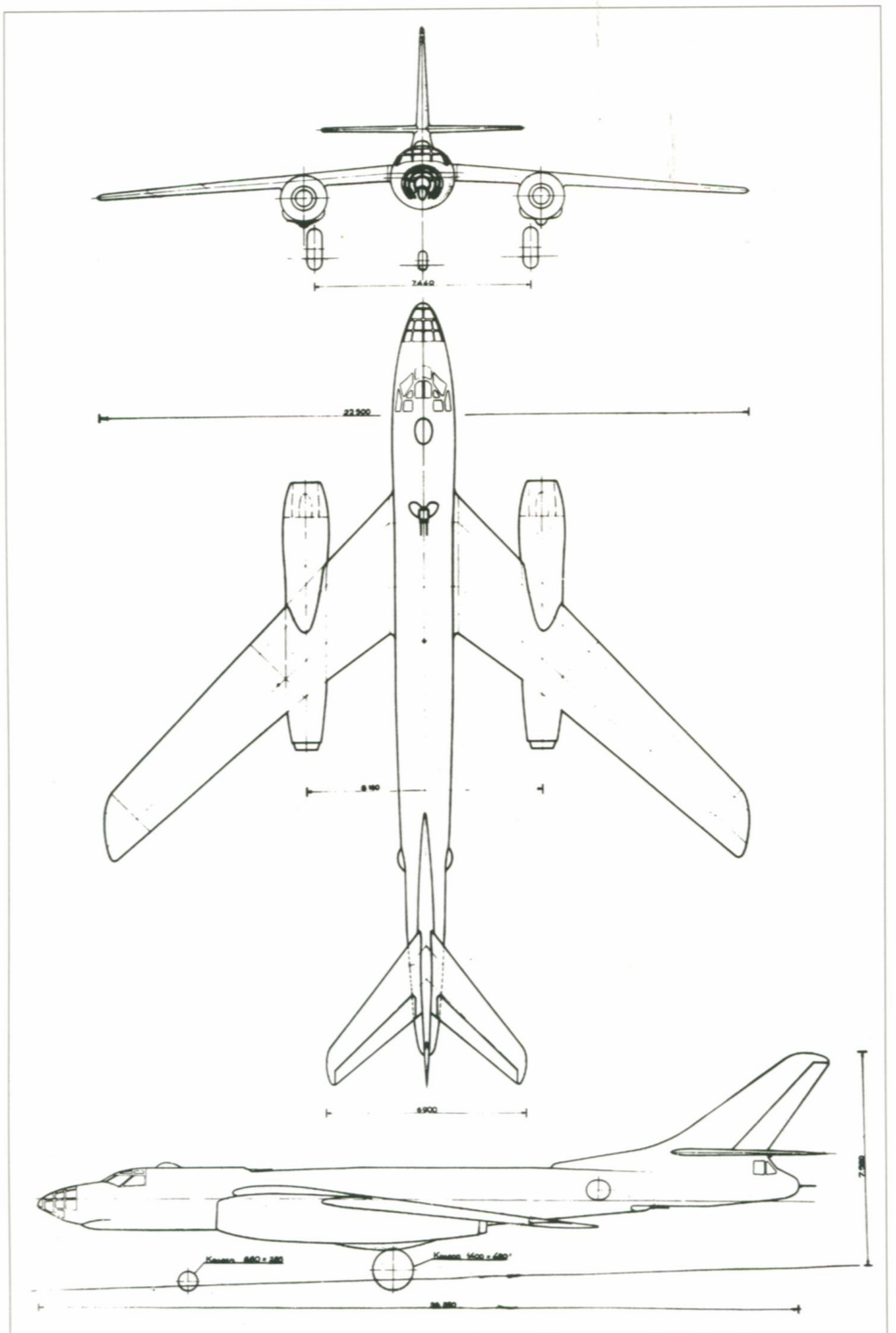
The '82' enabled the research on large aircraft with swept wings to be verified and was the first practical step towards the creation of the Tu-16 to be taken.

After the 'aircraft 82', OKB-156 began work on its fully combat-capable version, designated 'aircraft 83', which possessed a full complement of offensive and defensive armament. This differed from the prototype in having a longer fuselage measuring 19.925m and a crew of four, which included a gunner/radio-operator seated behind the pilot and controlling the dorsal gun position. The bomber was equipped with a PSBN radar sight (*pri****bor*** *sle****po****vo bombome****ta****niya i navi****gah****tsii* – 'blind bombing and navigation device'), with the option of replacing this with a RYM-S precision target guidance radar. The configuration of the fuselage fuel tanks was also revised. An AFA-BA/40 replaced the AFA-33/75 camera, and the shape and size of the pilot's canopy were altered. Construction of the '83' was begun at plant No 156, but all further work on it was terminated in 1949.

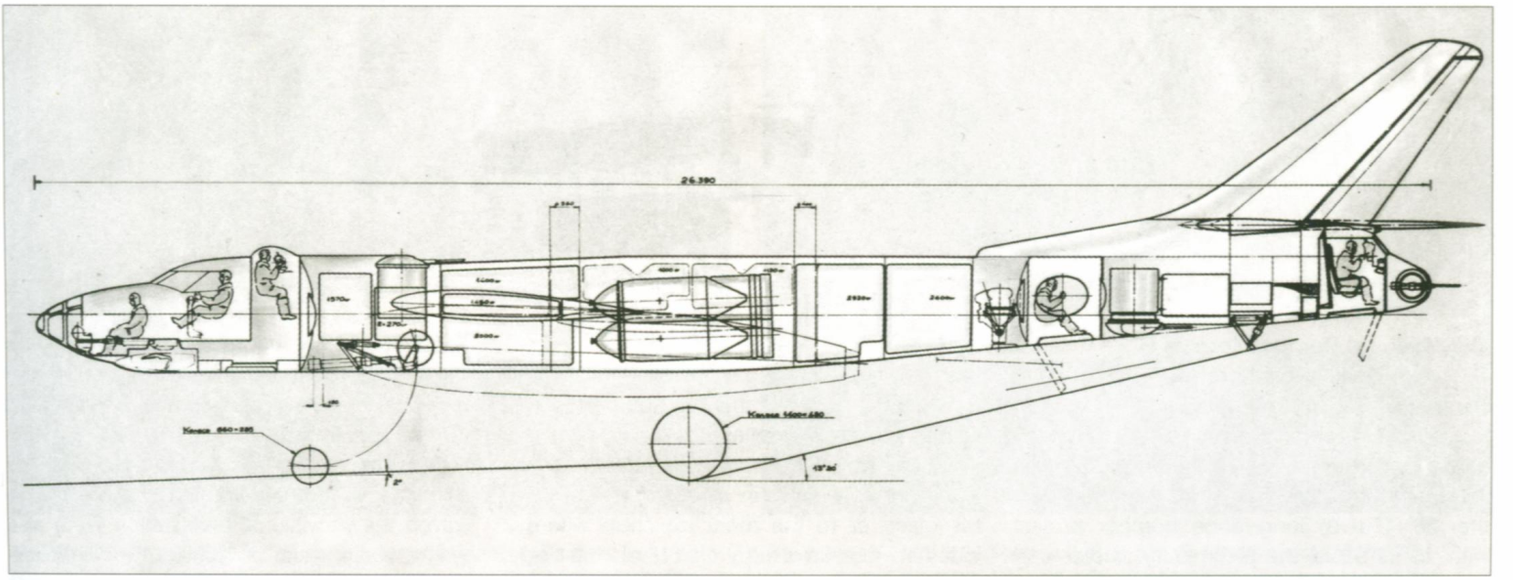
In mid-1948 OKB-156 began work on swept-wing medium and long-range bombers powered by two engines providing a total thrust of up to 10,000kg. The first in a series of projects was 'aircraft 486' (denoting the sixth project undertaken in 1948).

The initial project for the '486' bomber was based on a modification of the straight-winged 'aircraft 73' with increased engine power. The original three engines yielding a total static thrust of 5,600kg were to be replaced by two Mikulin AM-TKRD-02 (AM-02) engines providing a total thrust of 9,560kg, with the third engine mounted in the rear fuselage replaced by a rear gun position. Preliminary design calculations showed, however, that the increased thrust from the new engines would so increase the aircraft's speed that it would reach critical Mach numbers. Under these conditions, retaining the unswept wing was no longer viable. The transition to a swept wing was unavoidable. Added to this, the considerably higher fuel consumption of the new engines necessitated an increase in the fuel load by up to 10 or 12 metric tons.

The resulting new project, 'aircraft 486' was a high-speed medium-range bomber with a bomb bay able to carry large bombs, including bombs up to three metric tons in weight. The defensive armament comprised a fixed, forward-firing NR-23 cannon, and three other gun positions with a total of six G-20 cannon. The preliminary project for the '486' was assessed as follows:



A three-view drawing of the projected '491' tactical bomber (that is, 1949, project No 1) evolved from the '86'. Note how the mainwheels turned through 90° during retraction to lie flat under the engine jetpipes. Tupolev JSC



A cutaway drawing of the '491', showing the position of the bomb bay aft of the wing torsion box carry-through structure, with fuel tankage fore and aft of it. Note that there were three separate pressurised cabins; a reconnaissance camera was to be located ahead of the centre cabin. Tupolev JSC

Length	22.75m
Height	7.20m
Wing span	26.00m
Wing area	83.00m²
Wing sweep	34.5°
Wing aspect ratio	8.15
Wing taper	2.00
All-up weight	
Normal	26,000kg
Overload	31,500kg
Empty weight	18,500kg
Maximum speed	
at sea-level	990km/h
at 6,000m	1,020km/h
Range with 1,000kg bomb load	3,500-4,000km
Take-off run	1,700m
Crew	5

Work on the '486' was halted at the initial design stage but served as the basis for the project '86' long-range bomber.

At the end of 1948 OKB-156 began work on the '86' design – a long-range bomber with two AM-02 gas turbines, each providing 4,780kg static thrust. The designers took the layout of 'aircraft 486' as a starting point, but the '86' differed in having a larger bomb bay accommodating a normal load of 2,000kg and a maximum load of 6,000kg, a fuel load increased to between 5.2 and 17.2 metric tons, a greater flying weight, and a wider fuselage. A second pilot was included in the increased crew of six.

The forward pressurised cabin was completely reconfigured to feature a stepped nose without the predecessor's fighter-type canopy covering the pilots' cockpit, and the gunner/radio-operator was repositioned to a separate station under a blister dome. The nose undercarriage leg was lengthened, the main undercarriage legs given twin wheels and speed-brake flaps were installed on the rear fuselage. Defensive armament was augmented by a single NR-23 cannon and a PSBN radar mounted in the nose.

The project for 'aircraft 86' was subsequently revised. The fuselage was lengthened, the wing span and wing area were increased and greater fuel tankage provided. The nose became sharper, and the fuselage was reconfigured to house additional fuel tanks. The forward undercarriage leg was fitted with twin wheels, a single NR-23 cannon installed in the tail position, and the PSBN radar replaced by the improved PSBN-M. Figures for the revised '86' are as follows:

Length	27.48m
Height	8.25m
Wing span	27.49m
Wing area	100m²
All-up weight	
Normal	30,000kg
Overload	42,000kg
Maximum speed at 4,000m	950-1,000km/h
Service ceiling	13,000m
Range with 2,000kg bomb load	4,000km
Take-off run	1,000-1,200m
Landing run	500-600m
Crew	6

The research undertaken by OKB-156 in the course of work on the '86' showed that a viable long-range bomber could be created just by increasing the weight and dimensions of the aircraft and by increasing the engine thrust by 150-200%. Work on the '86' bomber was discontinued at the preliminary design stage, but the configuration of the fuselage was subsequently used on the '88' (Tu-16) design to which the OKB now turned its attention. The unavailability of the AM-02 engines made the OKB turn to the 4,500kgp TR-3 turbojet designed by Arkhip M Lyul'ka's OKB-165. The new bomber project was known as the '87' and hardly differed from the '86'.

In April 1949 OKB-156 produced the project 'aircraft 491' (denoting the first project for 1949), a faster version of 'aircraft 86'. With a wing sweep of 35° the reserve of power provided by the two AM-02 engines could not be used to the full; it was therefore decided to use wings sweptback at an angle of 45°. The designers took the first version of the '86' as their starting point and made the following changes:

- increase of the wing sweepback to 45°
- increase of the wing dihedral to 4°
- a complete revision of the wing centre section
- addition of new wingtip fairings
- lengthening of the centre fuselage section
- increased fuel tankage
- increasing the sweepback of the vertical and horizontal tail from 40° to 50°;
- lengthening of the nose undercarriage leg
- radical changes to the main undercarriage legs (which had single wheels of a new type)

To improve the aerodynamic shape of the engine nacelles, the cross-section of the AM-02's exhaust pipe was altered. The new cross-section (in the form of a figure-8) allowed the nacelles' cross-section area to be reduced and their aerodynamic qualities enhanced.

The project for the '491' bomber did not go beyond the stage of technical consideration. Preliminary calculations for the aircraft appear below:

Length	26.39m
Height	7.50m
Wing span	22.50m
Wing area	81.7m²
Wing sweepback	45.0°
Wing aspect ratio	6.2
All-up weight	
Normal	30,000kg
Overload	42,700kg
Empty weight	21,920kg
Maximum speed at 6,500m	1,085km/h
Service ceiling	13,500m
Range with 2,000kg bomb load	5,000km
Crew	6

Projects and Prototypes

The '494' Jet Bomber (project)

The simultaneous quest by TsAGI and Tupolev's OKB-156 ended in a rational solution to the many problems involved in the aerodynamic form of a heavy swept-wing aircraft. The most rapid progress was made in research on the '88' (Tu-16) long-range bomber project with, as its basis, the preliminary studies carried out by TsAGI on the chosen layout with a wing possessing an aspect ratio of 7-9 and sweptback at an angle of 35°. The prototype was designated E-4 at TsAGI, and wind-tunnel tests with a model were made between 1947 and 1950. The swept-wing chosen was in many ways identical to that used by German designers on the Junkers EF 132.

When Sergey V Il'yushin's OKB-240 was commissioned to design a high-speed long-range jet bomber (subsequently designated IL-46), OKB-156 did not abandon its work on its competing design and work continued with the aim of producing an aircraft with a higher performance than the IL-46. The initial research was carried out by B M Kondorskiy's team, in which young graduates of the Moscow Aviation Institute, such as Andrey A Tupolev, G A Cheryomukhin, Yu Yu Yudin, I V Babin, and V A Sterlin, began their careers and went on to become the OKB's leading experts and specialists. The first draughting of the layout and the first calculations were done under the close scrutiny of Tupolev who gave this project his particular attention. Subsequently, when the aircraft's layout, dimensions and correlations had been decided, Sergey M Yeger's team joined in the work followed by the remaining sections of the OKB.

While the layout of the aircraft and the proportions of its assemblies were being resolved, Tupolev visited S M Yeger's team each day and studied the progress in detail, he then went to his office or to the mock-up shop where a wooden mock-up of the aircraft was being made. Kondorskiy's team had the task of setting the aircraft's basic parameters (wing area, weights, and power of the engines) with which, and a crew of six, the following data were calculated:

Maximum speed	
at sea level	950km/h
at 10,000m	950-1,000km/h
Time to reach 10,000m	23 minutes
Service ceiling	12,000-13,000m
Range with normal bomb load	7,500km
Normal bomb load	6,000kg
Maximum bomb load	12,000kg
Unassisted take-off run	1,800m
Landing run	900m
Armament	as for 'aircraft 86'

These figures (apart from range and bomb load) were essentially in line with those for the earlier '86' project, and the dimensions of bomber '494' (the fourth project undertaken by the Kondorskiy team in 1949) and were based on data for the '86' project and on the papers entitled *Research into the Flight Characteristics of Heavy Swept-wing Jet Aircraft* carried out by OKB-156 in early 1948.

The research incorporated all the results derived from 'aircraft 86', but increased them in the light of the new requirements. The aircraft's power unit was based on the Lyul'ka TR-3A (AL-5) engine with a static thrust of 5,000kg, and on OKB-165's projected turbofan engine (given the provisional designation TR-5) also with a static thrust of 5,000kg. Some preliminary revisions to 'project 494' were also made to accommodate the AMRD-03 engine with an estimated thrust of 8,200kg on which Mikulin's OKB-300 was then working.

The aerodynamic characteristics of the new aircraft were identical to those of the '86' bomber, and some versions of the '494' bomber were geometrically similar to the '86'. The length of the bomb bay corresponded in length to that of the rear bomb bay on the '85' – which held 6,000-12,000kg of bombs – and the weights of the structural elements for various versions of the project were provisionally based on their '86' equivalents.

Work on the '494' bomber within the B M Kondorskiy team was the responsibility of I B Babin, G A Cheryomukhin and V A Sterlin. The team completed work on the project materials in June 1950, when the analysis and research resulted in a wing sweep of 36° and the following alternative engine types:

- two AMRD-03 engines;
- four TR-3A (AL-5) engines;
- four TR-5 engines.

Various provisional layouts for the aircraft were prepared depending on the choice of engines.

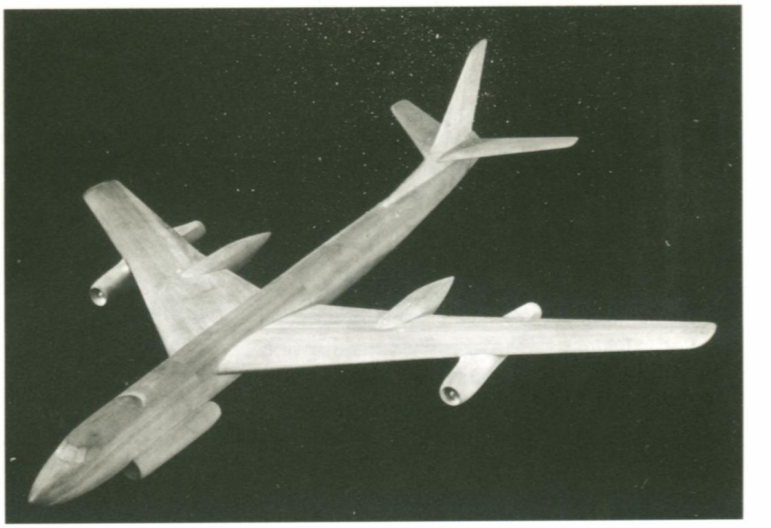
If the AMRD-03 engines were used with a wing area of 160-200m², two layouts were proposed:

1. In the first version the engines were housed in fairings which also contained the main landing gear. For this the following data were calculated:

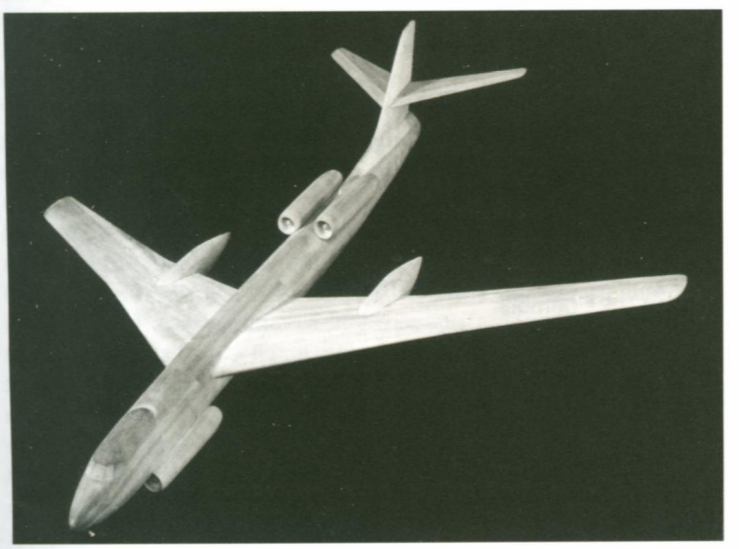
Fuselage length	37.1m
Wing span	34.8m
Wing area	160m²
Take-off weight	96,000kg
Landing weight	41,000kg
Fuel load	48,000kg
Weight of engines	8,300kg

The definitive '88' was preceded by several preliminary development projects. This is the '494/1' – basically a scaled-up '491', the main landing gear retracting into the engine nacelles adhering directly to the wing undersurface.
Tupolev JSC

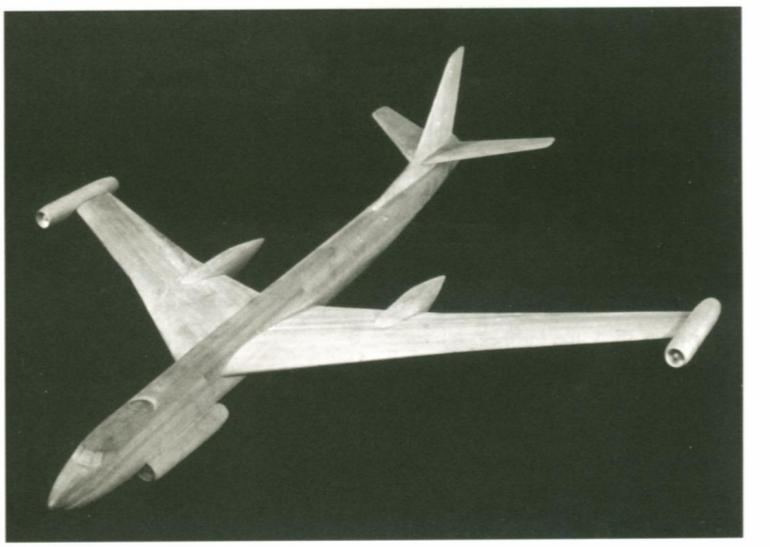
The '494/2' featured podded engines and redesigned main gear units with four-wheel bogies retracting aft into fairings protruding beyond the wing trailing edge – a trademark feature of Tupolev aircraft designed in the 1950s and 1960s. Tupolev JSC



The rather bizarre '494/3' combined the main landing gear of the '494/2' with two engines adhering to the forward fuselage underside and two more mounted on the wings, B-47 style. Tupolev JSC



The '494/4' was even more hair-raising – basically the '494/3' with two engines moved from the wings to a position atop the rear fuselage. This is where the unusual engine placement of the later Tu-22 ('105') comes from. Tupolev JSC



The ultimate cartoon – the '494/5' had two engines under the nose and two at the wingtips. Tupolev JSC

2. The second version had podded engines with the main landing gear in separate wing fairings. Thus, for the first time, OKB-156 came up with this method of housing the main undercarriage legs which became the 'trademark' of Tupolev designs in the 1950s and 1960s. It was based on German research derived from Göttingen in 1947 which incorporated the results of various wind-tunnel tests of various ways of locating engine nacelles relative to the wing: in front, beneath, above and behind. Placing the engine fairings behind gave the minimum drag for the wing-fairing combination. For this second version, the following data were calculated:

Fuselage length	37.0m
Wing span	34.8m
Wing area	160m²
Take-off weight	95,300kg
Landing weight	40,000kg
Fuel load	48,500kg
Weight of engines	7,200kg

For the TR-3A and TR-5 engines, the following layouts were proposed:

1. With a wing area of up to 130-160m², two engines would be located in the forward fuselage and two on the wings between the flaps and the ailerons, with the undercarriage legs in separate wing fairings.

2. With a wing area greater than 130-160m², all four engines would be located either in the fuselage, or two on the fuselage and two at the wingtips, or all four on wing pylons. All four layouts had the main undercarriage legs housed in separate wing fairings. The following data relates to the last version mentioned:

Wing area	200m²
Take-off weight	127,000kg
Landing weight	49,500kg
Fuel load	71,000kg
Weight of engines	16,300kg

3. This version had all the engines housed in pairs in wing fairings, one above the other, with the main undercarriage legs retracting forwards into them. Depending on the type of engines installed, the following date were calculated:

	TR-3A	*TR-5*
Length	40.2m	40.2m
Wing span	38.8m	38.8m
Wing area	200m²	200m²
Take-off weight	130,000kg	129,000kg
Landing weight	56,200kg	55,300kg
Fuel load	67,000kg	67,000kg
Weight of engines	13,700kg	12,700kg

For the TR-3A engines, a layout in which they were housed in wing fairings in side-by-side pairs was proposed. The main undercarriage legs retracted into the engine fairings (special rear fuselage fairings). In this form, the following data applied:

Length	32.7m
Wing span	31.3m
Wing area	130m²
Take-off weight	78,500kg
Landing weight	35,700kg
Fuel load	36,000kg
Weight of engines	10,330kg

The '495' Jet Bomber Project

In addition to the layouts described above, there was a version of the '494' with two AL-5 engines installed in fairings beside the fuselage (the wing area was to be 140m²). In this variant the aircraft had a highly stressed bicycle undercarriage with wing outrigger struts and auxiliary fuselage struts. Both TsAGI and the Tupolev OKB came up with this method of positioning the engines.

In OKB-156 this layout, as well as the project for the '88' bomber, were proposed by A A Tupolev. Wind-tunnel tests of a model with this configuration yielded very good aerodynamic results. The right choice of layout contributed a lot to the future success of the Tu-16.

The following conditions governed the preliminary layouts developed from the '498' project:

- the crew, armament and equipment were to be the same as for the '86'
- the wing planform was to be similar to that of the '86' bomber
- the stability coefficients derived from the '86' project (the rear fuselage length/wing span ratio was taken from the '498' project but was close to the ratio accepted for the '86')
- the layout of the bomb bay was to be similar to the rear bomb bay on the '85' bomber, which fixed the minimum diameter of the fuselage at 2.5m
- the maximum fuselage fineness ratio was to be of the same order as for the '85'
- the maximum permitted tyre pressure was to be 9-10kg/cm²

The basic data for the aircraft derived from preliminary layouts for the '494' were as follows:

Wing area, m²	100	130	160	200	240
Take-off weight*	57-60	75-80	93-96	126-132	152-158
Fuel load*	24	36-39	48.5	71	85.6-87.5

* weight expressed in tonnes

The essential differences between the layouts devolved mainly on the type of engines and their positioning, while, at the same time, the configurations for the fuselage were basically analogous to that of the '86'.

An analysis of the layouts provided a number of practical conclusions. As the dimensions of the aircraft increased, the layout in which the engines were housed in the same fairing as the undercarriage became less workable due to the greater cross-section and surface area of the fairing and the loss of thrust due to the greater length of the jetpipe.

The layout in which the undercarriage and engines were housed in separate fairings offered less overall drag, primarily shock-wave drag. This was because the interference of the undercarriage fairings and the pylon-mounted engine fairings with the wing was minimal and could not substantially increase the degree of shock-wave drag as the angle of attack increased:

- engines in pylon-mounted nacelles greatly facilitated maintenance since the engines were easily accessible from the ground
- locating the engines in a wing with an area of up to 300m² without any corresponding increase in the wing root chord and related thicknesses in comparison with the '86' wing was inefficient
- locating the engines in the fuselage was difficult due to the inevitable heating of the fuselage structure and interference by exhaust gases with the bomb bay doors (if the engines were forward of the wing) or with the tailplane and glazing of the tail gun position (if the engines were mounted behind the wing)

As was evident from this analysis, the most efficient layout for a medium-sized bomber (and that chosen by B M Kondorskiy's team) was the one in which the engines were mounted on pylons and the main undercarriage legs retracted into wing fairings. But TsAGI was, at that time, very cautious about the idea of pylon-mounted engines and it was, therefore, not widely used on Soviet aircraft at this time. Engines mounted on pylons (or, to use the Soviet terminology of the time, on 'knives') were used only on the Soviet-German '150' bomber designed under the direction of Brunolf Baade, and later on the IL-54, although pylon-mounted engines were also considered during design work on such aircraft as the M-4 and Tu-95.

The performance data for seven differently powered variants of the bomber were examined within the confines of the 'wing area/take-off weight' ratio (with a bomb load of 6,000kg):

- two AMRD-03 engines with and without afterburning
- four TR-3A engines with and without afterburning
- four TR-5 engines with and without afterburning
- four non-afterburning AMRD-03 engines

The results of this analysis showed that if the maximum range was to be achieved with the same expenditure of fuel, the twin-engined layout using two AMRD-03 engines was preferable to the four-engined layout with TR-3A or TR-5 engines (on account of the reduced drag and weight of the power plants). The rest of the performance data for a set range and take-off run could be deduced, given the following minimum conditions:

- take-off weight, 60,000-70,000kg
- wing area, 150-170m²
- total take-off thrust, 14,000-16,000kg

Given a minimum thrust of 12,000-14,000kg, the set range and take-off run could be achieved by increasing the dimensions of the aircraft: the take-off weight had to be 70,000-80,000kg and the wing area 190-210m².

The research precisely defined the parameters for the optimum number and type of engines for the subsequent design of a long-range jet bomber (given the specified performance). The following conclusions were drawn:

- the limits within which the specified performance could be achieved were significantly extended if the overall power of the engines was increased
- the limits for a twin-engine layout (AMRD-03) were wider than for a four-engine layout (TR-3A) and wider for turbofan engines (TR-5) than for pure turbojets (TR-3A)
- given the specified performance for a long-range bomber, the take-off weight should be within the range of 60,000 to 100,000kg, the wing area 150 to 250m², and the total thrust available greater than 12,000-14,000kg

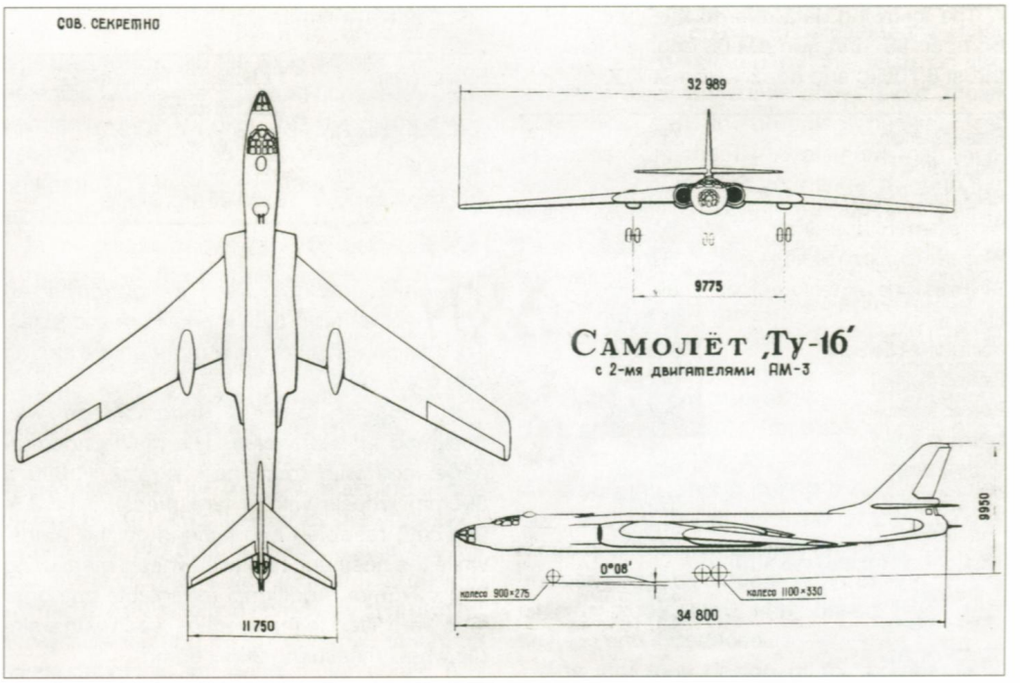
This work defined the design, and subsequent development, of a long-range subsonic jet bomber. These precepts were essentially vindicated with the creation of the Tu-16 and other aircraft of its class.

In the summer of 1950 the results of the different versions of the future long-range bomber were discussed at a conference held at OKB-156. The material on the variants of the '494' project was presented by I B Babin and G A Cheryomukhin, while A A Tupolev presented his own project. After lengthy consideration Chief Designer A N Tupolev decided to go ahead with the bomber which received the in-house code 'aircraft 88'. The bomber was to combine all the best features of the most advanced versions of the '494' and A A Tupolev's project (the fuselage layout and the wing with undercarriage fairings were to be based on the '494', while the location of the engines was to follow A A Tupolev's project). Thus, in this first approximation, the Tu-16 took shape – an aircraft which, for a number of years, evoked the admiration of the world's aviation community.

The '88' Jet Bomber Prototype

OKB-156's pursuit of the optimum version of the new long-range bomber with a higher performance than that promised by the IL-54 was welcomed not only by the Soviet Air Force but by the Soviet government as well, and it was decided to commission the new aircraft from the Tupolev OKB. This decision followed the pattern of scientific and technological policy set by the country's leadership in the post-war period when new types of weaponry, aircraft included, were to be created. For Tupolev it was an opportunity to redress his failure in the undeclared contest with OKB-240 for the USSR's first tactical jet bomber.

On 10th June 1950 the Soviet Council of Ministers issued directive No 2474-974, followed on 14th June by order No 444 from the Ministry of Aircraft Industry (MAP – *Min**ister**stvo aviat-si**on**noy pro**mysh**lennosti*) in which A N Tupolev's OKB-156 was tasked with designing and building a long-range jet bomber powered



A three-view drawing of the Tu-16 bearing this designation. Tupolev JSC

by two Lyul'ka TR-3F (previously designated TR-3A and subsequently AL-5) engines with a thrust of some 5,000kg. The performance of the new aircraft was to approximate to that extrapolated by the OKB in the course of its preliminary design (PD) studies. Two prototypes of the new bomber were to be built, with the first of these ready for State acceptance trials in December 1951. The commissioning documents relate to the design of a bomber with two AMRD-03 engines, each with a take-off thrust of 8,000kg. However, due to the workload imposed on the OKB by work on the Tu-85, on 28th November 1950 the deadlines for *izdeliye* (article) '88' were postponed by three months.

As related above, the choice of the final layout for the new bomber was preceded by a great deal of research work, which was continued in even greater detail even after the final fundamental layout had been decided upon.

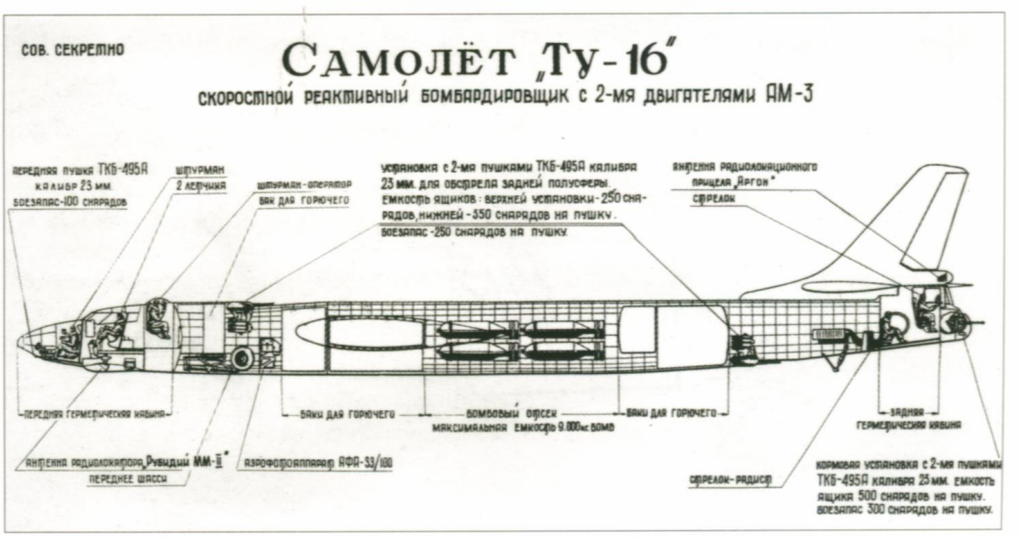
The complex task of determining the aircraft's dimensions and final aerodynamic and structural layout was resolved by intense parametric research, and numerous experiments with both model and full-size forms. It became evident in the course of this work that the total thrust of the two AL-5 engines would be clearly inadequate to achieve the specified performance. It was therefore decided to use two AMRD-03 (production designation AM-3) engines. A version with four AL-5 engines was envisaged as a back-up configuration, but in this form the take-off weight would be greater.

A N Tupolev decided in February 1951 that work would concentrate on the version with two AM-3 engines designed by OKB-300, but the matter was not finally resolved until several months later when OKB-300 built and tested a real example of the AM-3. On 24th August 1951 a new directive was issued by the Soviet Council of Ministers, followed on 30th August by MAP order No 832, according to which 'aircraft 88' was to be powered by AM-3 engines with a take-off thrust of 8,700kg and a specific fuel consumption (SFC) of 1.0kg/kgp·h. The static thrust at nominal rating was to be 7,000kg, and at cruise rating 6,400kg (with a corresponding SFC of 0.95kg/kgp·h and 0.93kg/kgp·h respectively). The dry weight of the AM-3 engine was anticipated to be no more than 3,100kg.

The new engine was to be submitted for State bench tests in December 1951. Hence, to speed up development work, the MAP order No 948 of 22nd September called for the adaptation of a Tu-4 to serve as an engine testbed for the AM-3. The Tu-4LL testbed was to be ready by November. As early as August 1951 the first two examples of the AM-3 were to be delivered to OKB-156: one for bench trials and the second for flight testing on the Tu-4LL (construction number 230113). They were to be followed by two more intended for the first '88' prototype which were scheduled for delivery in November 1951 – with a third example in January 1952 intended as a reserve. At this point the bomber's future depended to a considerable degree on the successful conclusion of tests on the world's most powerful turbojet engine.

Design work on the AMRD-03 had begun in 1949 in Aleksandr A Mikulin's OKB-300. In 1952 the engine successfully passed its State bench tests and was placed in large-scale production as the AM-3. It was the first Soviet turbojet with a powerful thrust, and it remained for many years the standard power plant for large military and civil aircraft. The engine had an eight-stage axial compressor, a cannular combustion chamber, a two-stage turbine and a fixed-area nozzle. Swirl vanes were fitted at the entry to the combustion chamber. The engine was also fitted with combustion tube cooling using ribbed plates, a jet fuel starter for automatic self-contained starting, an adjustable deicing system, and an oil/fuel heat exchanger for cooling the oil, using the engine fuel. The AM-3 possessed a compressor with subsonic high-pressure stages which provided a pressure ratio of 6.2, and for the first time compressor adjustment could be effected by air bleed valves after the first compressor stages. Pin-hole disc connection in the drum-type rotor facilitated blade alignment. In OKB-300 the work on this engine was headed by Prokofiy F Zoobets.

The active design work on 'aircraft 88' got under way immediately after a Soviet Council of Ministers directive issued in June 1950. The Soviet Air Force issued a specific operational requirement for the new bomber on 10th July, which was slightly amended on 11th September after the decision to use the AM-3 engine had been taken. The general design work was finished on 20th April 1951 with the completion of the advanced development project (ADP) and its submission to the Soviet Air Forces' Aviation-Technical Committee, which signed its confirmation on 29th May. The draft project with AM-03 engines was finally confirmed on 5th July.



A cutaway drawing of the Tu-16, showing the position of the bomb bay, fuel tanks and defensive armament. Tupolev JSC

The following data refer to the draft project bomber '88' with twin AM-03 engines (take-off thrust 8,700kg and nominal thrust 7,000kg):

Fuselage length	33.6m
Wing span	33.0m
Height from runway	8.9m
Wing sweep at quarter-chord	35°
Wing area (excluding centre section)	159m²
Wing area (including centre section)	164.59m²
Empty weight	32,760kg
Normal take-off weight	64,500kg
Payload (normal)	14,190kg
Payload (overload)	31,740kg
Maximum speed	
at sea level *	840km/h
at 5,000m	988km/h
at 10,000m	918km/h
Time to height (normal / max AUW)	
to 5,000m	3.6 / 5.5 mins
to 10,000m	9.0 / 14.5 mins
Service ceiling	
with normal weight	12,800m
with maximum weight	12,000m
Range / endurance †	
with a fuel load of 28,500kg	6,000km / 7.5 hours
with a fuel load of 27,500kg	5,750km / 7.3 hours
with a fuel load of 25,500kg	5,300km / 6.7 hours
with a fuel load of 21,500kg	4,380km / 5.5 hours
Take-off run/take-off distance	
with maximum all-up weight	1,500 / 3,650m
Landing run with a	
landing weight of 37,000kg	670-750m

* limited to an altitude of 3,600m by a dynamic pressure limit of 3,400kg/m², from 3,600m upwards – maximum permissible Mach 0.86; † with a take-off weight of 64,500kg, flying at 11,200-14,400m and a cruising speed of 780-840km/h.

The aircrew was to consist of six. The following ordnance combinations could be carried:

Type/quantity	Total weight
Bombs	
24 x FAB-250 M-46 HE bombs	6,000kg
18 x FAB-500 M-46	9,000kg
6 x FAB-1500 M-46	9,000kg
2 x FAB-3000 M-46	6,000kg
1 x FAB-5000 M-46	5,000kg
1 x OGAB-6000	6,000kg
1 x FAB-9000 M-46	9,000kg
Mines	
12 x AMD-500	6,000kg
4 x AMD-1000	4,000kg
4 x AMD-M	4,800kg
4 x Desna	3,000kg
4 x Serpei	5,000kg
4 x Lira	4,000kg
Torpedoes	
3 x 45-36-AVA	3,000kg
3 x TAV	3,800kg
3 x A-2 (RAT)	1,830kg

In some cases a bomb load of up to 12,000kg could be carried.

The defensive armament to be fitted was:

Forward-firing	1 x Nudelman/Rikhter NR-23 (with 100 rounds)
Rear dorsal position	2 x NR-23 (with 250rpg)
Rear ventral position	2 x NR-23 (with 250rpg)
Tail gun position	2 x NR-23 (with 300rpg)

The crew positions were armour-protected from behind, from below and from the sides. The overall weight of the armour on the aircraft was to be 545kg.

An original form of undercarriage was designed for the aircraft. The main undercarriage legs with four-wheel bogies (1,000 x 300mm wheels with a tyre pressure of 8.5-9kg/cm²) retracted into fairings on the wings, while the nose unit had twin wheels measuring 900 x 275mm. Additional retractable outrigger legs were fitted to the wingtips, each with a single wheel measuring 265 x 80mm.

According to the ADP documents, the aircraft was to carry the following basic equipment:

- electrical equipment: 4 x GSR-1800 generators, 2 x 12SA-65 DC batteries
- communications equipment: 2 x 1RSB-70 command link radios, RSIU-3 communications radio, AVRA-45 emergency radio, SPU-10 intercom
- navigation equipment: 2 x ARK-5 automatic direction finders, Materik instrument landing system, Meridian SHORAN, RV-2 and RV-10 radio altimeters
- radar: Rubidiy-MM bomb-aiming radar with a FARM photographic adapter, Argon gun-laying radar in the tail, Bariy-M and Magniy-M2 IFF transponders
- photographic equipment for opportunity and planned reconnaissance: AFA-33/50, AFA-33/75 and AFA/33/100 day cameras or NAFA-3s night cameras for vertical photography; AFA-33/75 and AFA-33/55 for oblique photography
- oxygen equipment: 6 x KP-24 breathing apparatus, SKZhU-50 liquid oxygen converter
- autopilot: AP-5M

Work on the full-scale mock-up was begun in June 1950 and completed on 20th April the following year. Its first inspection by Soviet Air Force representatives on 16th February resulted in a list of 101 items to be corrected, and the second inspection on 8th March produced a further 25. All these were taken into account during subsequent work on the aircraft. Officially the mock-up, together with the ADP, was shown to Air Force representatives on 20th March 1951. The mock-up review commission chaired by Soviet Air Force Commander-in-Chief S I Rudenko worked between 2nd June and 7th July, approving the mock-up on the latter date. The installation of additional equipment in the aircraft and work on the second prototype (called *doob**lyor***, lit. 'understudy', in Soviet terminology of the time) led to another mock-up review commission which sat between 18th and 26th March when matters relating to equipment and armament were finally agreed with the Air Force, and the earlier criticisms taken into account.

This prolonged period until agreement was reached resulted from the large number of original technical features incorporated in 'aircraft 88', which made it rather different from its predecessors.

The central portion of the airframe (comprising the fuselage/wings/air intakes/engines/undercarriage), which gave the aircraft its high aerodynamic qualities, corresponded in fact to the concept of 'area ruling' first introduced into the world aircraft design practice in 1954. On the 'aircraft 88' bomber this was expressed in the form of 'squeezing' the engine fairings in the area of the wing/fuselage joint, and the slender wing fairings housing the main gear units. These and other aerodynamic measures subsequently contributed to the aircraft's speed of 1,040km/h (Mach 0.92) when the RD-3M engines were fitted.

The engines were located in the wing roots aft of the second spar, with lateral air intakes ahead of the wings. Air was fed to each engine along two ducts, one passing through the wing torsion box and the other passing beneath it. This placement of the engines solved the problem of interference at the point where the wing met the fuselage – the most difficult junction in aerodynamic terms. This particular problem was solved by introducing an 'active fillet': the jet exhaust sucked away the air flowing round the wing and fuselage, at the same time directing the air flow in that zone. Those who took part in the design work recalled that, at the outset, there was an inherent desire to minimise by all means possible the cross-section at the point where the fuselage, fairing and wing met (for that reason the engines were located as deeply as possible). Tupolev himself insistently advocated and monitored this solution. He constantly inspected the proposed layout for the bomber and demanded that the designers 'compress, compress, and compress again'. When the model of the aircraft was tested in the TsAGI wind-tunnel after all these compressions its specialists could not understand how the drag had been so drastically reduced, and it took them a long time to report the conclusion of their findings to the OKB.

As the bomber was designed to fly at high subsonic speeds, its tail surfaces had a greater degree of sweepback than the wings. Thanks to this, the phenomena associated with 'shock stall' affected the tail later than the wing. In practical terms, this allowed the machine to retain its stability and handling at high speeds.

The bomber was further distinguished by a number of other special features. A high wing aspect ratio (about 7) was chosen. The spar webs of the two spars and the upper and lower wing panels between the spars formed its basic structural element – the torsion box. The strong, rigid box made the wing of the '88' quite different from those of the long-range American

bombers, the B-47 and B-52. These machines had flexible wings, which facilitated the damping of vertical gusts due to their considerable deformation. The more rigid wing of 'aircraft 88' was less subject to deformation in flight due to its reduced stress. The wealth of operational experience later amassed with the Tu-16, the Tu-104 airliner in the USSR and the American Boeing 707, Douglas DC-8 and Convair 880 Coronado airliners proved that the more rigid wing construction was more robust, especially from the point of view of structural fatigue. The Americans had to overcome many operational problems involving the wings of the B-47 and B-52 (fatigue cracks and, as a result, repeated revision and reinforcement of the structure).

Installing the engines in the wing roots close in to the fuselage required an unusual design for the engine are intake ducts, which had special frames (at first made up from a number of pieces and later comprising a single stamped part) for the main air flow fitted in the root area of the first and second spars, with auxiliary air intakes under the wing. This arrangement allowed the necessary airflow for the AM-3 engine to work normally at the cost of a relatively small increase in weight in the wing root area and the wing centre section structure.

One attribute of the bomber was its extensive fuselage bomb bay located behind the centre section's rear spar. Thanks to this the bomb load was carried close to the centre of gravity and the bay itself did not intrude into the wing's load-bearing structure. The strength and rigidity of the fuselage in the area of the bomb bay were ensured by very strong longitudinal beams.

The crew was accommodated in two pressurised cabins with ejector seats for all crewmembers. The rear (tail) pressure cabin housed two gunners – unlike earlier heavy bombers – improving their combat co-ordination and boosting morale (the tail gunner was no longer 'alone out there').

The bomber's defensive armament consisted of three remote-controlled turrets with twin cannon, a fixed forward-firing cannon, four optical sighting posts and an automatic rear sight. This distribution improved the bomber's defensive capability in level flight, and was greatly superior to the defence systems of comparable contemporary bombers. It was intended to use either the long-range Topaz (which has only ceased development recently) or the shorter-range Argon (then being readied for series manufacture) as a tail gun ranging radar.

The original undercarriage design with two four-wheeled bogies, which rotated through 180° as they retracted, enabled the aircraft to be operated from concrete, earth or snow surfaces. The forward undercarriage leg had, for the first time on a Soviet aircraft, a pair of wheels on a single common axle to reduce vibration and reduce the risk of shimmy oscillations. The method of retracting the main undercarriage legs backwards into the wing fairings was later patented (somewhat later and completely independently of the Tupolev OKB, this method was used on the British Vickers Valiant B.Mk.2). A brake parachute was provided for emergency landings.

In the course of design work on the aircraft, a number of disagreements arose between leading specialists in OKB-156 and TsAGI about the use of irreversible power-assisted controls, and their use on large high-speed aircraft was insistently recommended by the specialists at TsAGI. But the poor reliability of the first Soviet hydraulic actuators for aircraft made them unsuitable for the new machine in the opinion of the OKB's specialists (A N Tupolev's dictum that 'the best hydraulic actuator is the one on the ground' is well-known). The designers had therefore to find some way of providing acceptable loading for the controls, which, on an aircraft of this size flying at high speed, had to have very small hinge moments. The difficult problem was solved after numerous model and full-size tests had been carried out in TsAGI's wind tunnels.

As 'aircraft 88' was to become the first Soviet nuclear weapons carrier to become operational in large numbers (the ten examples built of the Tu-4A could not provide a reliable 'deterrent shield'), the Tupolev OKB, as well as other organisations working to provide the 'nuclear shield', were faced with the task of ensuring the delivery aircraft's safety once its nuclear weapon had exploded. Such new phenomena as the spread of the powerful nuclear shock wave in a heterogeneous atmosphere, taking into account the effect of wind and its altitude variations, and the flash, either diffused or reflected, as it passed through an atmosphere charged with various particles, had to be explored. The parameters of the effect of a nuclear explosion on the aircraft had to be determined. This essentially involved issues of aerodynamics and structural strength. Would the shock wave destroy the bomber? Would the aircraft be crushed by the pressure differential following the shock wave? Would the crew have to take over control of the aircraft? Particular attention had to be paid to the effect of the heat generated by the flash on the relatively weak duralumin alloy. (Later, those who took part in dropping nuclear test weapons from the Tu-16 affirmed that afterwards you could push your finger through the duralumin skin covering the aircraft's belly.) These questions necessitated co-operation with specialists from TsAGI, from other organisations and from the Soviet Air Force Research Institute named after Valeriy P Chkalov (GK NII VVS – *Gosoo**dar**stvennyy krasnozna**myon**nyy na**ooch**no-is**sled**ovatel'skiy insti**toot** Vo**yen**no-voz**doosh**nykh seel*). An experimental base was built to simulate the complex effects produced on the aircraft during a nuclear explosion, and by the second half of the 1950s a range of effective measures to protect the new nuclear weapons carriers in the air and on the airfields where they were based had been devised and introduced.

The structural design of the bomber, the materials used, its equipment and systems as well as the manufacturing technology involved, were chosen and developed with due regard to the actual capabilities of the Soviet aircraft industry. This enabled an airborne strike system, which was to become one of the fundamental aspects of the Soviet deterrent, to be created within the shortest possible time.

The blueprints for the first prototype designated '88/1' (and referred to in internal correspondence as *za**kaz*** 881, 'order 881') were prepared and delivered to the experimental construction facility at plant No 156 between February 1951 and January 1952 – actually in parallel with the machine's construction; work went on in 'live update' mode, so to say, with reciprocal on-the-spot correction of both the actual airframe and the drawings. Work on setting up the jigs began in April 1951, and in May the front part of the fuselage was already assembled. By the end of 1951 the first prototype was completed and a static test airframe was built in parallel. On 26th December A N Tupolev signed order No 27 for the machine's transfer to the flight test centre in Zhukovskiy.

The first prototype Tu-16 (the '88/1') at the Flight Research Institute's airfield in Zhukovskiy. The fixed forward-firing cannon on the starboard side of the nose is clearly visible. Tupolev JSC

On 25th January 1952 *izdeliye* '88/1' was transported to Zhukovskiy for further development work and flight tests, and on 30th January the bomber was parked on the apron reserved for Tupolev's machines. From then on the individual testing and checking of every piece of equipment began, the engines were ground-run, and new items of equipment delivered by various suppliers were installed. Final installation of all systems was completed three days before the first flight – on 24th April. Even while all this work was under way, on 25th February 1952, the prototype was submitted for factory flight testing.

The 'aircraft 88' static test article (*izdeliye* '88/0' or 'order 880') was also completed by the end of 1951 and delivered to TsAGI on 26th December. Static tests at TsAGI were held between 15th January and 28th November 1952. At the end of March that year OKB-156 completed the structural strength calculations. The static tests and strength calculations produced the following initial planning data:

Fuselage length	33.5m
Wing span	33.0m
Wing area	166.0m²
Maximum take-off weight	64,000kg
Normal all-up weight	48,000kg
Landing weight	
with four AL-5 engines	51,200kg
with two AM-3 engines	42,500kg
Estimated Mach number	0.86
Max dynamic pressure for 64,000-kg AUW	
with a G load of 6	3,450kg/m²
with a G load of 4.3	2,700kg/m²

The flight crew for the first prototype was headed by test pilot N S Rybko and included co-pilot M L Mel'nikov, chief engineer for the flight tests B N Grozdov and chief engineer from OKB-156 I A Starkov. Chief designer Dmitriy S Markov was permanently in charge of all work on the bomber from the first prototypes to the last production aircraft.

The data below refer to the '88/1' bomber with two AM-3 engines recorded at the start of the manufacturer's flight tests.

Fuselage length	34.6m
Height on ground	9.85m
Wing span	32.977m
Wing area	164.59m²
Wing sweep at quarter-chord	35°
Operating empty weight	41,050kg
Take-off weight:	
normal	57,720kg
maximum	77,350kg
Payload	
normal	16,670kg
maximum	37,300kg
Fuel load	
normal	12,470kg
maximum	32,100kg

The crew consisted of six. The first prototype was designed to carry the following ordnance loads:

Type/quantity	Total weight
Bombs	
24 x SAB-100-55 flare bombs	2,400kg
18 x FAB-500 M-46 HE bombs	9,000kg
18 x BRAB-500 armour-piercing	9,000kg
6 x FAB-1500 M-46	9,000kg
6 x FAB-3000 M-46	6,000kg
2 x BRAB-3000	6,000kg
1 x FAB-5000	5,000kg
1 x BRAB-6000	6,000kg
1 x FAB-9000	9,000kg
16 x FAB-250 M-43	4,000kg
12 x FAB-500 M-43	6,000kg
4 x FAB-1000 M-43	4,000kg
4 x FAB-2000 M-43	8,000kg
Mines	
12 x AMD-500	6,600kg
4 x AMD-1000	4,500kg
4 x AMD-2M & 6 x AMD-500	7,560kg
8 x AMD-2M	8,560kg
8 x IGD-M	8,560kg
6 x Serpei	8,700kg
8 x Desna	6,000kg
8 x Lira	7,600kg
4 x A-2	2,440kg
Torpedoes	
6 x 45-36 AMV	6,984kg
4 x RAT-52	?

It was planned to install the following experimental, still not fully developed, defensive armament on ' aircraft 88/1':

- an NU fixed forward-firing gun mount with the experimental Afanas'yev/Makarov TKB-495A (with a lengthened barrel, given the designation AM-23 in service) with 100 rounds
- a DT-V7 dorsal turret with two TKB-495A cannon and 250rpg
- a DT-N7 ventral turret with two TKB-495A cannon and 350rpg
- a DK-7 tail turret with two TKB-495A cannon and 500rpg

This armament was not ready when factory tests began, and the machine was tested in unarmed configuration.

The undercarriage layout of the PD project was revised: the first prototype lacked the wingtip outrigger struts, the main units had bogies fitted with 1,100 x 330mm KT-16 brake wheels and the nose unit was fitted with 900 x 275mm K2-70/2 non-braking wheels.

The basic equipment fit essentially corresponded to that for the draft project, but as the Rubidiy-MM and Argon radars and the Meridian SHORAN were still not ready for flight testing they were not fitted. It was decided to install them when they became available during the course of test and development work.

The '88/1' underwent its first taxying trials for an hour on 24th April 1952. A second taxying test took place the next day, and on 27th April the aircraft made its 12-minute maiden flight. Factory tests continued until 29th October 1952. In all, 46 flights were made, the aircraft logging a total of 72 hours and 12 minutes. During the tests a top speed of 1,020km/h was attained, which exceeded the specified figures. The bomber turned out to be overweight, with a TOW of 77,350kg and an empty weight of 41,050kg (versus the estimated 64,000kg and 35,750kg respectively), which could not but affect performance, particularly range and field performance. A reduction in weight of at least 5-6 tons was required – and consider that the first prototype did not carry the full complement of equipment.

Performance data derived from the factory tests of the '88/1' are given below:

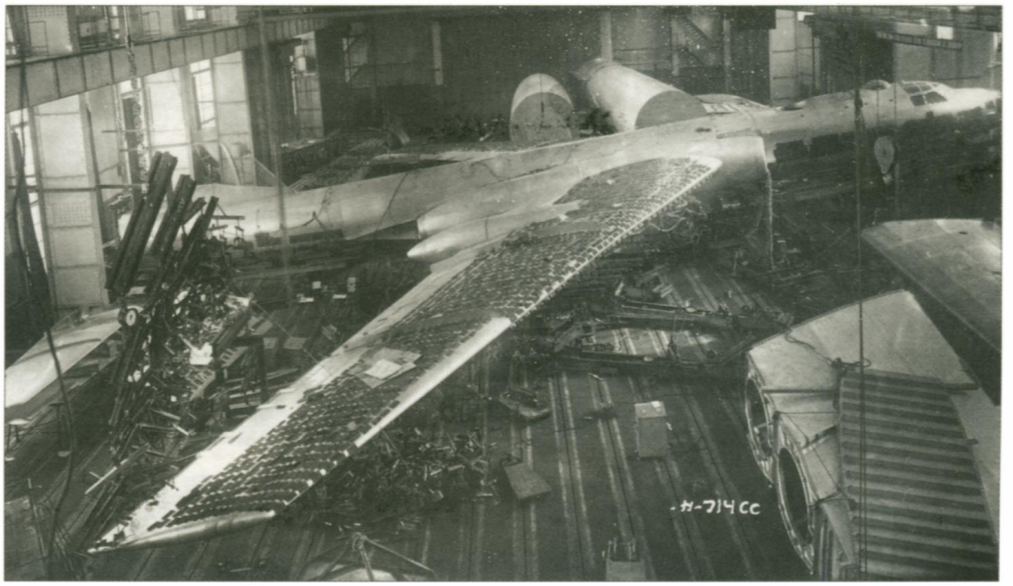
Maximum speed *	
at sea-level	690km/h
at 5,000m	1,020km/h
at 7,000m	1,002km/h
at 10,000m	962km/h
at 12,000m	930km/h
Range †	6,050km
Range ‡	6,050km
Service ceiling over the target	12,300m
Time to height:	
to 6,000m	6.4 mins
to 10,000m	13.0 mins
Take-off run/take-off distance	
with an AUW of 76,000-77,000kg	1,980 / 3,750m
Landing run/landing distance	
with a landing weight of 50,200kg	1,510 / 2,354m

* at a weight of 57,500kg (limited by dynamic pressure of 2,300kg/m² up to 7,000m); † with a 77,128-kg TOW, a 3,000-kg bomb load and a 32,100-kg fuel load; ‡ with a 75,848-kg TOW, a 9,000-kg bomb load and a 25,740-kg fuel load.

Building on the results of the factory tests it was decided to submit the machine for State acceptance trials, despite the fact that it was overweight. The primary task was to evaluate the bomber as a strike system while simultaneously trying to reduce its weight and achieve the specified performance figures. The aircraft was accepted for State trials by GK NII VVS on 13th November 1952, the trials commencing two days later at the LII airfield in Zhukovskiy. They were interrupted on 30th March 1953 by a heavy landing after a routine test flight. Over a comparatively short space of time the GK NII VVS test-pilots made 79 flights in the '88/1' totalling 167 hours and 28 minutes.

The data below was derived from the state trials:

Operating empty weight	40,940kg
Take-off weight	
normal	61,500kg
maximum	77,430kg
Payload	
normal	20,560kg
maximum	36,490kg
Fuel load	
normal	16,070kg
maximum	32,000kg



The '88' static test airframe undergoing destructive testing at TsAGI. The blocks glued to the wings' upper surface are designed to pop off as the stress increases, indicating critical deformation. Tupolev JSC

Maximum speed	
at sea level*	690km/h
Max speed at full power	
at 7,500m	1,005km/h
at 10,000m	962km/h
at 12,000m	916km/h
Max speed at nominal power	
at 7,500m	980km/h
at 10,000m	941km/h
at 12,000m	881km/h
Range / endurance †	
at 10,000-13,100m	5,610km / 7 hrs 10 min
Range / endurance †	
at a constant height of 10,000m	5,260km / 6 hrs 48 min
Range ‡	
at 10,000-12,900m	4,390km
Endurance ‡	
at a constant height of 10,000m	5 hours 44 minutes
Operational range †	
at 10,000-13,100m	
(with 5% fuel reserves)	5,200km
Max endurance †	
at 10,000m	8 hours 15 minutes
Service ceiling	12,200-13,100m
Time to height:	
5,000m	5.7 mins
10,000m	16.2 mins
Take-off run/take-off distance	
with a 77,430-kg TOW	2,320/4,000m
Landing run/landing distance	
with a 50,200-kg landing weight	1,540/2,480m

* with a 57,500-kg AUW limited by a dynamic pressure of 2,300kg/m² up to 7,000m; † with a 77,430-kg TOW, a 3,000-kg bomb load and a 32,000-kg fuel load; ‡ with a 77,430-kg TOW, a 9,000-kg bomb load and a 26,000kg fuel load

In spite of the reasonably good performance figures, the first prototype failed its State acceptance trials for the following fundamental reasons:

- the mission equipment did not function satisfactorily
- the full complement of defensive armament was not fitted
- the radar equipment was missing

As well as this, the aircraft had to be repaired. The State commission decided to continue the trials with the lightened second prototype – '*izdeliye* 88/2', built at an accelerated tempo at experimental plant No 156. The repaired '88/1' was subsequently used for testing and refining the special equipment and the engines.

Series production of the '88' was decided on even while the State trials were in progress. Council of Ministers directive No 3193-1214 of 10th July 1952 and MAP order No 804 instructed that:

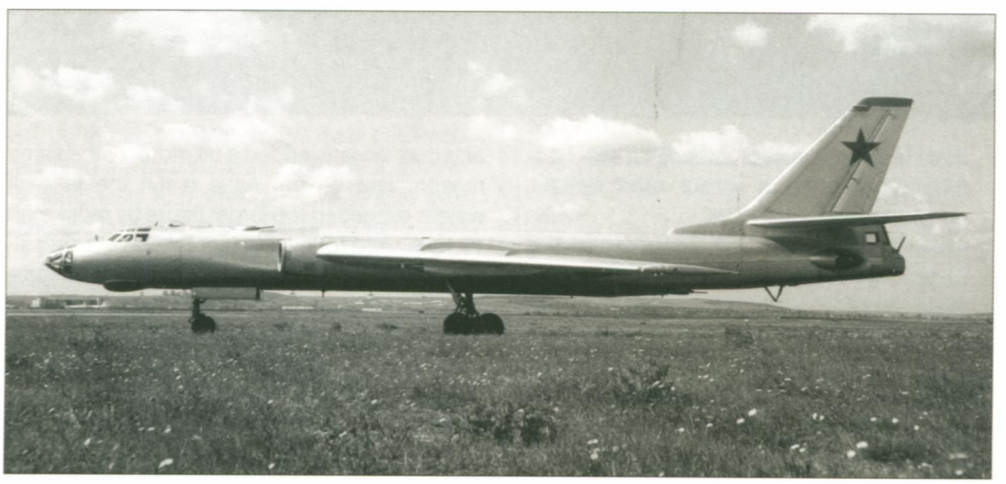
- preparations for series production be launched at plant No 22 in Kazan' without waiting for the completion of the State trials
- aircraft '88' be allocated the service designation Tu-16
- series production of the Tu-16 commence in July 1953 according to the following schedule: one example in July, one in August, two in September, three in October, three in November and five in December
- before 1st August 1952 the first prototype was to perform an additional maximum-range test flight
- a new gun ranging radar capable of detecting fighter-type targets at no less than 15-17km range be developed for the Tu-16 (this project bore the codename Topaz)
- MAP and the Tupolev OKB were to submit for State trials in September 1952 a Tu-16 with a take-off weight of 48,000-55,000kg, a bomb load of 3,000-9,000kg, a technical range of 6,000-7,000km, a service ceiling of 13,000m, a take-off run of 1,500-1,800m and a defensive armament of seven 23mm cannon (in accordance with the amendments to Council of Ministers directive No 3125-1469 of 24th August 1951)
- production of the Tu-4 at plant No 22 be terminated
- series production of the AM-3 turbojet be organised at aero engine factory No 16 in Kazan', with 70 engines to be supplied in 1953
- state trials of the Tu-16 be concluded in December 1953
- service evaluation be carried out with the first 15 examples built at plant No 22

The '88' gained its excess weight in the course of the first prototype's design and construction. The primary reason for this had been the constant over-cautiousness of the structural strength department and the designers' concern both for the aircraft and their own fates. (It should be borne in mind that the Tu-16 came into being during the ultimate years of the Stalin regime when any kind of mistake could result in imprisonment – or worse.) Everyone wanted to be on the safe side. Designers at the 'grass roots' level added an extra 10% – just in case, and their bosses added a bit more for the same reason, and so on. As a result the take-off weight exceeded the target figure by more than 10 tons! Add to this the fact that, at the outset, the choice of powerplant was not yet finalised – aircraft had to be designed for either four AL-5s or two AM-3s, – which also added unnecessary weight. As a consequence, there was more than enough excess weight that could be shed – and this was done on the second prototype of the '88'.

The second prototype, designated '88/2' ('order 882'), was built in accordance with the same Council of Ministers directive by and MAP order but without any set deadlines. Originally it was regarded merely as a 'duplicate' of the first prototype; however, by the late summer of 1951, when the '88/1' was almost completed, it became obvious that the machine was overweight. Tupolev charged his OKB with the task of reducing the aircraft's empty weight as much as possible. This in itself involved redesigning much of the structure and OKB-156 organised a 'weight-trimming diet' in the course of which it was planned to 'slim down ' the machine.

This work focused on three major areas. Firstly, the non-stressed structural elements had to be lightened. Secondly, it was necessary to reduce the weight of the load-bearing elements as much as possible without compromising their structural strength by reducing the number of manufacturing joints and fasteners (for example, the multi-part duct frames were replaced by integral units made of AK-8 aluminium alloy, and the D-16 duralumin used in several parts of the airframe was replaced by V95 high-strength aluminium alloy). In addition, single-piece pressed profiles with variable cross-sections were incorporated together with large pressed parts, large sheets and the like.

Thirdly, it was agreed with the Soviet Air Force that the flight manual would impose a speed limit up to an altitude of 6,250m, at which altitude the aircraft would not normally be involved in combat operations. The calculated dynamic head pressure below this height was reduced from 2,700kg/m² to 2,200kg/m².



The second prototype ('88/2') at Zhukovskiy during trials, with several Tu-4s in the background. The old control tower visible just aft of the tail in the three-quarters front view is still in existence, as are the huge hangar and office building to the left.
Tupolev JSC

These measures reduced the aircraft's empty weight from 41,050kg to 36,490kg. Design of the new lighter aircraft was completed in November 1952. By this time the blueprints for the 'heavy' version had already been supplied to plant No 22 and preparations for production were going full steam ahead. Replacing these blueprints with the ones for the 'lightened' version and resetting the jigs was fraught with a delay in the start of series production, with predictable consequences for those responsible. At this difficult moment Tupolev, supported by the MAP top executives, took the courageous and vital decision to put the lightened version of the Tu-16 into production. At the same every measure was taken to shorten the delay until the first bombers had been produced. All blueprints and corrected drawings had been supplied to plant No 22 by the end of 1952, and the realistic deadline for the first production Tu-16 delivery postponed from July to October 1953.

Design work on the *dooblyor* began in August 1951, with construction of the aircraft at OKB-156's prototype factory taking place simultaneously. The blueprints which included all the corrections aimed at lightening the aircraft were prepared by the OKB between May and December 1952. The second prototype ('88/2') was finished in early 1953 and trucked to the test and development centre at Zhukovskiy on 13th February.

On 2nd March MAP issued order No 272 'legalising' the lightened prototype. This document contained provisos about the take-off weight (70,000kg) and the maximum dynamic pressures at medium and low altitudes (2,200kg/m^2 below 6,250m). The aircraft was to be ready for renewed State acceptance trials in June 1953. The production plant (plant No 22) was to provide TsAGI with a lightened version of the production Tu-16 for renewed static tests. The epic story of the bomber's lightening programme culminated in the following episode. Since the heads of OKB-156 had deviated from the generally accepted rules, a scapegoat had to be found. The formal pretext was the second prototype's inadequate top speed during State trials (992km/h instead of the specified 1,000-1,020km/h), which led the Minister of Aircraft Industry to issue a formal rebuke to Dmitriy S Markov who was in charge (which remained on his record for a long time until finally cancelled – and which he rightly and perversely could take pride in). He was 'rewarded' for the improved, and, as it turned out highly successful aircraft, by a formal note in his employment certificate and personal record.

Apart from the revisions mentioned above, the *dooblyor* was also refined in the course of its design and construction. A number of criticisms made during the first tests flights of the '88/1' were taken into account, and some changes made when equipment not available earlier was eventually fitted. In particular:

- the fuselage nose was lengthened by 0.2m to increase crew comfort and accommodate equipment more easily
- the fuel capacity was increased from 38,200 litres to 43,900 litres (limited at first to 36,200 litres due to concerns about structural strength) by installing fuel tanks in the outer wing panels;
- the tailplane was reinforced and given a torsion box structure like the wings
- the engine housings were slightly widened to facilitate engine installation and maintenance
- the air/air heat exchanger in the air conditioning system (ACS) was replaced by a cooling turbine and the air intake for the ACS was altered
- critical comments made by the State commission on the first prototype's test results were acted upon (in particular, this concerned the fitting and operation of the mission equipment)
- DT-V7, DT-N7S and DK-7 turrets with TKB-495A cannon were fitted (later replaced by updated TKB-495AM (AM-23) cannon)
- a PS-48M optical sighting station, a PRS-1 Argon gun-laying radar, an experimental model of the Rubidiy MM-2 ground mapping radar and an OPB-11R vector-synchronised bombsight (in place of the OPB-10S optical bombsight) were fitted
- KP-24 oxygen masks replaced the KP-16 masks
- a modernised AP-5-2M autopilot was fitted
- PO-4500 single-phase AC converters were installed to power the radars

By March 1953 all the refinement work on the *dooblyor* was done, and on 14th March it was cleared for flight tests. These were carried out by a crew under test pilot N S Rybko, with co-pilot M L Mel'nikov (who had been co-pilot on the '88/1') and test engineer M M Yegorov who had done excellent investigative and development work on the Tu-4 and Tu-70 engines, as well as during the testing of the first Tupolev jets.

The '88/2' moved under its own power for first time on 28th March, and the 30-minute first flight followed on 6th April. The manufacturer's tests were completed on 12th September. The basic data relating to the factory tests appear below:

Length overall	35.2m
Fuselage length	34.8m
Height (theoretical)	10.355m
Height (practical)	9.85m
Wing span	32.989m
Wing area	164.65m^2
Wing aspect ratio	6.627
Wing taper	2.6416
Wing sweep at quarter-chord	35°
Landing gear track	9.775m
Landing gear wheelbase	10.913m
Empty weight	36,810kg
All-up weight	
normal (in max-range flight)	52,500kg
maximum	71,040kg

Head-on view of the second prototype, showing the air intakes and the original design of the main gear doors with one-piece quasi-triangular segments at the front of the oleos. The hangar visible beneath the starboard wingtip is the rival Myasishchev OKB's experimental shop and flight test facility. Tupolev JSC

Payload	
normal	15,690kg
overload	35,230kg
Fuel load	
normal	11,490kg
overload	30,030kg
Max speed at take-off power	
with a 52,500-kg AUW	
at 5,500m	1,002km/h
at 10,000m	944km/h
at 12,000m	905km/h
Rate of climb with 56,000-kg AUW	
at 2,000m	16.3m/sec
at 6,000m	11.6m/sec
at 10,000m	7.2m/sec
Time to altitude with 56,000-kg AUW	
to 6,000m	6.7 mins
to 10,000m	13.8 mins
Service ceiling over the target	
before bomb release	12,900m
after bomb release	13,200m
Max technical range	
with a 71,040-kg AUW *	6,015km
with a 72,000-kg TOW †	5,760km
Take-off run/take-off distance ‡	
with a 56,200-kg TOW	1,220 / 2,215m
with a 71,000-kg TOW	1,700m / n.a.
Landing run/landing distance §	
landing weight 43,600kg	1,200 / 1,840m
landing weight 47,000kg	1,360m
Landing run/landing distance ¶	
landing weight 48,470-kg	1,760-2,553m

*with a 3,000-kg bomb load (flying a 'hi-hi-hi' mission profile) and a 30,030-kg fuel load; † (flying a 'hi-hi-hi' mission profile) and a 3,000-kg bomb load; ‡ to 25m at take-off power and 20° flap; § with brake parachute deployed and 35° flap; ¶ without brake parachute with 35° flap

On 16th September 1953 'aircraft 88/2' was cleared for renewed State trials and was accepted by GK NII VVS two days later. The trials, held between 26th September 1953 and 10th April 1954, were held almost exactly a year after the *dooblyor*'s first flight. Sixty-five test flights with a total flying time of 154 hours and 33 minutes were made in the course of the trials by a test crew captained by A K Starikov (who later performed the greater part of the Tu-104 airliner's test programme) Apart from the tests of the aircraft itself, its systems underwent trials concurrently – in particular, the AM-3 engines, the experimental Rubidiy MM-2 bombing radar, the PS-48M optical sighting stations and the experimental Argon gun ranging radar.

Data derived from these trials of '88/2', which served as the yardstick for the first production Tu-16 bombers and were used as standards in their manuals, are given below:

Length overall	35.2m
Fuselage length	34.8m
Height of aircraft (theoretical)	10.355m
Height of aircraft (practical)	9.85m
Wing span	32,989m
Wing area	164.65m²
Wing aspect ratio	6.627
Wing taper	2.6416
Wing sweepback at quarter-chord	35°
Landing gear track	9.775m
Landing gear wheelbase	10.913m
Dry weight	36,600kg
Empty weight	
(with trapped fuel, starter fuel and oil)	37,040kg
All-up weight	
normal for technical range	55,000kg
maximum	71,560kg
maximum for exceptional occasions	72,000kg
Permitted landing weight	48,000kg
Payload	
normal	17,960kg
overload	34,520kg
Fuel load	
normal	13,660kg
overload	30,220kg
maximum for exceptional occasions	30,660kg
Crew weight	600kg
Bomb load	3,000kg
Weight of ammunition for cannon	700kg
Max speed at take-off power *	
at sea level	675km/h
at 6,250m	992km/h
at 10,000m	938km/h
Max speed at nominal power *	
at sea level	675km/h
at 6,250m	958km/h
at 10,000m	915km/h
Maximum Mach number	0.876
Unstick speed	
with a 57,000-kg take-off weight	250km/h
with a 71,560-kg take-off weight	280km/h
Landing speed	
with a 44,000-kg landing weight	223km/h
Service ceiling, at nominal power	
with 57,000-kg take-off weight	12,800m
with 71,560-kg take-off weight	11,300m
Time to reach service ceiling	
with a 57,000-kg take-off weight	31 mins
with a 71,560-kg take-off weight	38 mins
Maximum technical range ('hi-hi-hi'):	
with a 57,000-kg take-off weight†	5,640km
with a 71,560-kg take-off weight†	5,760km
Combat radius	2,415km
Take-off run ‡	
with a 57,000-kg take-off weight	1,140-1,885m
with a 71,560-kg take-off weight	1,900-3,165m
Time from brake release to unstuck	
with a 57,000-kg take-off weight	28.7 secs
with a 71,560-kg take-off weight	45.0 secs
Landing run §	
without brake parachute	1,655-2,785m
with brake parachute	1,050-2,180m

* with a 55,000kg all-up weight; † with a 3,000-kg bomb load; ‡ (take-off distance to 25m) at take-off power with 20° flap; § with a 44,000-kg landing weight and 35° flap:

The '88/2' prototype passed its trials with GK NII VVS purely in its bomber form. Tests of the mine and torpedo armament were deferred to be carried out on a specially modified production machine which would serve as the 'standard' for the Tu-16 torpedo bomber/minelayer. During the trials the Tu-16 was loaded with the following types of bombs:

- Normal bomb load (3,000kg) 24 x FAB-100
- Maximum bomb load (9,000kg) 24 x FAB-250
  or 18 x FAB-500
  or 6 x FAB-1500
  or 2 x FAB-3000
  or 1 x FAB-9000

During the course of the trials 12 TsOSAB-10 coloured flare bombs were carried.

After receiving approval from the State commission 'aircraft 88/2' was recommended for series production and operational service with the Soviet Air Force.

Subsequent production machines differed outwardly from the two prototypes ('88/1' and '88/2') as follows. A different type of aerial was installed atop the extreme nose (above the navigator's station forward of the flightdeck); two 'towel rail' aerials were added on the upper fuselage sides aft of the flightdeck. The shape of the dorsal antenna ahead of the navigator/dorsal gunner's observation/sighting blister (serving the SPI-1 radio) was also different, and the pitot tubes were repositioned. Finally, the small one-piece doors of quasi-triangular shape hinged at the front of the main undercarriage oleos gave place to rectangular clamshell doors.

Tu-16 Versions, Development and Series Production

The Tu-16's production history and many years of operational service involved numerous and varied versions (production series, prototypes, experimental adaptations and testbeds). Some of these were purpose-built, others were refits. The overall number of versions exceeded 80, and there were many projects which were never realised.

The first line of development concerned the bomber version and its modifications. The Tu-16 carried a conventional bomb load; the Tu-16A could carry nuclear weapons as well. They were followed in production by the Tu-16 (ZA) and the Tu-16 (ZA), both of which were equipped for wing-to-wing in-flight refuelling (IFR). After this, the IFR capability became an almost standard feature and later models had no special suffix to denote it. The prototype Tu-16B was fitted with more powerful and fuel-efficient engines.

The Tu-16T torpedo-bomber (*torpedo**nos**ets*) was virtually identical to the bomber version, but with a revised weapons bay. Later, the torpedo-bombers were refitted as Tu-16PLO anti-submarine warfare aircraft (*protivo**lod**ochnaya obo**ron**a* – ASW) and as Tu-16S maritime search and rescue aircraft (*pois**kov**o-spa**sah**tel'nyy* – SAR, used attributively), the later carrying a lifeboat.

Some bombers were adapted to carry guided bombs – the UB-2F Chaika (Seagull) and Condor munitions – on external hardpoints. A projected version carried these weapons internally.

The refuelling tanker versions were similar to the bombers. The Tu-16(Z) used the wing-to-wing system, while the Tu-16N and Tu-16NN utilised the probe-and-drogue system. Additional fuel tanks were housed in the bomb bay, and hose drum units were installed in the starboard wing (in the case of the Tu-16Z) or the bomb bay. When these were removed, the aircraft could operate as conventional bombers.

The second line of development lay in the adaptation of the Tu-16 as a missile carrier able to strike at both land and naval targets with equal success. The first of these was the Tu-16KS armed with *Ko**met**a* (Comet) air-to-surface missiles (ASMs) which was produced in series. With the development of the more sophisticated K-16 and K-11 ASMs, the Tu-16KS aircraft were upgraded to carry them, the Tu-16KSR-2 being armed with the K-16 and the Tu-16K-11-16 with either the K-16 or the K-11.

The Tu-16KS and its derivatives had one major drawback; they could not be used as conventional bombers. At the same time, the number of Tu-16KSs built could not satisfy the existing demand for missile strike aircraft, and bomber versions had to be converted. This led to the advent of the Tu-16KSR-2A and Tu-16KSR-2-11 versions able to carry the K-16 or K-11 ASMs while retaining their capability as bombers.

With the arrival of the more sophisticated K-26 ASM, earlier versions of the Tu-16 were refitted to carry it: 'straight' Tu-16 bombers and Tu-16KSR-2A bomber/missile carriers were upgraded to Tu-16KSR-2-5 standard, the Tu-16KSR-2-11 was converted into the Tu-16KSR-2-5-11, and the Tu-16KSR-2 and Tu-16K-11-16 into the Tu-16K-26. The all-purpose Tu-16KSR-2-5 and Tu-16KSR-2-5-11 strike aircraft were produced in larger numbers than any other missile-toting version of the Tu-16.

The Tu-16K-26 generated the more advanced Tu-16K-26P and Tu-16K-26-07 versions. A limited number of Tu-16K-26s and Tu-16KSR-2-5s was equipped with the new Rubin-1M (Ruby, pronounced *roo**bin***) radar. Two examples of the Tu-16KSR-2-5 with this radar were converted into Tu-16 *Tsik**lon**-N* (Cyclone N) weather research aircraft. A small number of Tu-16KSR-2As was refitted as Tu-16KSR-IS aircraft.

Some Tu-16KSR-2-5s, Tu-16K-11-16s and Tu-16K-26s were equipped to carry bombs; a few of these could take an increased bomb load. New types of ASMs were tested, using the Tu-16K-22 as a delivery vehicle.

Versions adapted to carry target drones were similar to the ASM carriers. These versions (the Tu-16KRM, Tu-16NKRM, Tu-16KRME and Tu-16NM) were produced for the Air Defence Force (PVO – ***Pro**tivovoz**doosh**naya obo**ron**a*) and were able to launch rocket-powered target drones.

The third line of development was the creation of special naval versions – both ASM carriers and reconnaissance aircraft. These differed significantly in configuration from the Tu-16 and Tu-16KS with reconfigured weapons bays and a new YeN radar installed in the nose. The first of these aircraft was the Tu-16K with new engines and the K-10 ASM. It was placed in production as the Tu-16K-10 but the production version was powered by the same old AM-3s. It was followed by the upgraded Tu-16K-10D, Tu-16K-10N and Tu-16K-10P. When the K-26 and K-26P ASMs became available, these naval ASM carriers were refitted as the Tu-16K-10-26, Tu-16K-10-26N and Tu-16K-10-26P. The Tu-16K-10-26B version could also be used as a bomber, as the B suffix (for *bombardi**rov**shchik*) reveals.

When the Tu-16K-10 and Tu-16K-10D became obsolescent, they were converted into Tu-16RM-1 and Tu-16RM-2 maritime reconnaissance aircraft. The variant for filming had its cannon armament replaced by special ciné cameras.

The fourth line of development lay in specialised reconnaissance and electronic countermeasures (ECM) versions. The Tu-16R differed considerably from the original bomber, carrying dedicated equipment and an additional crew member as operator The Tu-16RM was an upgraded version, and the Tu-16RR radiation reconnaissance aircraft collected air samples and analysed them for nuclear fallout, chemical and bacteriological contamination. The Tu-16RE version carried an ECM set in addition to its normal reconnaissance equipment, while the Tu-16RTs provided mid-course guidance for submarine-launched missiles.

The first ECM versions were highly specialised machines. The Tu-16 ***Yol**ka* (Spruce) was equipped for passive ECM and the Tu-16SPS for active ECM. The Tu-16 *Yolka* was later fitted with active ECM as well, and the Tu-16SPS had automated ASO-16 equipment which led to the ECM versions being combined. The resulting Tu-16E had a bigger crew than the Tu-16SPS.

The most sophisticated ECM version was the Tu-16P, on which the bomb bay was replaced by a special compartment to house the *Bu**ket*** (Bouquet) ECM suite. A small number of Tu-16Ps carried rockets to provide passive ECM, and some had the Ficus ECM system with directional antennas. The last version carried the very powerful Cactus ECM set.

The fifth line involved prototype and experimental machines, as well as testbeds. Some versions remained in prototype form for the following three reasons. Firstly, the prototype was built to achieve some technical end, which might prove successful but production status would be frustrated by a variety of reasons – political, economic and so on. Mention has been made of the Tu-16B and Tu-16K prototypes. They were successful in term of their specifications, but the late 1950s and early 1960s saw a drastic cutback in aircraft development work. Both machines had new

A mix of Tu-16 variants was often operated by the same unit. Here, Kazan'-built Tu-16K-11-16 '52 Red' (c/n 5202009) with the characteristic inverted-T antenna array on the nose shares the flight line with a Kuibyshev-built basic bomber coded '09 Blue' (c/n 1880904), a Tu-16E 'Azaliya' ECM aircraft with the characteristic boattail fairing housing an active jammer ('29 Blue') and six other aircraft in bomber and ECM configurations coded '30 Blue', '26 Blue', '32 Blue', '24 Blue', '22 Blue' and '34 Blue'. A Tu-22M3 bomber/missile strike aircraft is visible beyond, along with two seemingly non-airworthy Tu-16s banished to the grass verge to avoid occupying apron space. Note the open entry hatches. Yefim Gordon archive

engines, but in the prevailing climate of thought neither aircraft nor their intended engines went into production. An IFR-capable version equipped with a refuelling probe did not reach operational status, as it was not considered viable to convert the existing fleet of Tu-16s.

A second reason was that the prototype failed to meet the specified technical or performance target. A case in point was the Tu-16 fitted with RD-3MR engines equipped with thrust reversers; the aircraft did not see series production.

A third reason involved the prototype's creation for a specific purpose only. Some Tu-16 were converted into airborne command posts during tests of a certain cruise missile, but were reconfigured back into their original guise once the tests were over. This, however, did not always happen: the Tu-16 Tsiklon-Ns served in this form until the end of their service lives. Experimental versions were used for important aspects of technical research. They were usually custom-built at production factories but a few were converted from 'second-hand' examples requisitioned from the Air Force. Sometimes the research involved another type of aircraft. For example, tests of the 'jump strut' developed for the nose gear unit of Myasishchev's M-50 bomber were carried out on a Tu-16. Testbeds were used for verifying and developing new systems, assemblies, equipment and engines, as well as for multifarious experimental and research purposes. For instance, the Tu-16 was used for testing the DK-20 cannon-equipped tail turret, the K-22 ASM system, the PN navigation/attack radar created for the Tu-22K missile strike aircraft and the like, as well as for aerodynamic research. Most prominently, the Tu-16LL was used as a test-bed for many Soviet jet engines.

The sixth course of development concerned the adaptation of the Tu-16 for the Civil Air Fleet (GVF – *Grazh**dahn**skiy voz**doosh**nyy flot*), or Aeroflot (the sole Soviet airline). There were only a few of these adaptations: for aerial photography, weather research and for carrying the matrices of national newspapers. They were also used to train GVF aircrews during their conversion to the Soviet Union's first jet airliner, the Tu-104. These adaptations were specially fitted out and lacked armament.

Many Tu-16s ended their days as remote-controlled target drones. A limited number were built in China which developed a few versions of its own.

The Tu-16 was built in quantity between 1953 and late 1963. Early production examples lacked IFR equipment. Only eleven versions of the Tu-16 (the Tu-16, Tu-16A, Tu-16KS, Tu-16K-10, Tu-16T, Tu-16R with SRS-1 or SRS-3 communications intelligence (COMINT) sets, the Tu-16 Romb (Rhombus) with the SRS-3 COMINT suite in the bomb bay, the Tu-16E and Tu-16 Yolka with the ASO-16 automatic chaff dispenser, the Tu-16P and the Tu-16SPS with SPS-1 or SPS-2 active jammers) were built as such at three factories. The numerous other versions were refits of earlier production models. Thus the Tu-16R and Tu-16P were built only at plant No 1 in Kuibyshev (now renamed back to Samara), although Kazan'-built examples of these versions (identifiable by their construction numbers) can be encountered. The exception is the single example built with the *Sili**kat*** (Silicate) experimental ECM system; while not officially listed as a production machine, this aircraft was **not** a refit (subsequently this Tu-16 had the *Sili**kat*** system replaced by a *Fo**nar'*** (Lantern) ECM set.

Over its entire manufacturing period the Tu-16 was built at three factories in 105 batches covering all versions (apart from the Tu-16K-10). Production rates varied over the years when the Tu-16 was in production. Most examples were built in 1955-1957; more than a thousand were produced in the course of these three years.

Between 1953 and 1959 plant No 22 named after S P Gorbunov at Kazan'-Borisoglebskoye produced the following versions: the baseline Tu-16 bomber, the Tu-16A nuclear weapon carrier, the Tu-16KS missile strike aircraft and the Tu-16E ECM version. In 1958 the factory initiated series production of the Tu-104B airliner; a year later it launched production of the Tu-22 supersonic bomber – at which point Tu-16 production was temporarily suspended. In 1957-59 several experimental and pre-production examples of missile strike versions (earlier production machines refitted as Tu-16K-10s) were produced for the Soviet Naval Air Arm (AVMF – *Avi**aht**siya vo**yen**no-mor**sko**vo **flot**a*). In 1959 plant No 1 completed the first production Tu-16K-10; however, in 1961, when the Kuibyshev factory switched to missile production, series production of this version was reinstated at plant No 22, with the last example leaving the factory in December 1963.

Until the late 1980s, Tu-16s had the construction numbers stencilled on the forward fuselage and on the fin in large digits; later, however, they were not carried visibly for security reasons. The c/ns of Kazan'-built examples are deciphered as follows. For instance, a Tu-16KS with the tactical code '25 Blue' was c/n 6203125 – that is, year of manufacture 1956, plant No 22 (the first digit is omitted to confuse would-be spies), batch 031, the 25th aircraft in the batch. Batches 1 through 10 consisted of five aircraft each; the number was increased to ten per batch from Batch 11 onwards, then to 20 from per batch from Batch 26 onwards and finally to 30 per batch from Batch 31 onwards.

OKB-156, LII or GK NII VVS documents sometimes quote abbreviated c/ns. For example, 'Tu-16 No 101' was a reference to the aircraft whose c/n was 3200101 (unfortunately the abbreviated form cannot be used to reconstruct the complete c/n unless you know when and where the aircraft was built). Additionally, some Kazan'-built Tu-16s carried a four-digit number on the tail below the c/n, the first digit likewise matching the year of production; for instance, Tu-16KS '49 Red' (c/n 7203608) was marked 7124, while Tu-16K-11-16 '54 Red' (c/n

The experimental Tu-16P 'Rezeda' ECM aircraft ('17 red' c/n 5202907) heads a long line of sister ships at Vladimirovka AB, Akhtoobinsk, including a missile strike aircraft coded '14 Red' (c/n 6401208). All of these aircraft were eventually converted into M-16 target drones by GK NII VVS. Yefim Gordon

Five naval Tu-16s fly in echelon starboard formation over a Soviet Navy destroyer during an exercise. Yefim Gordon archive

8204022) was marked 8191. However, while these numbers accrue continuously, they do not match the c/n sequence and the meaning is unknown.

The Tu-16K-10 was built in 30 batches, each comprising five aircraft; oddly, these did not continue the sequence of the previous Kazan'-built batches (Nos 1 through 42), being allocated the numbers 51 through 80. With the exception of the two prototypes, Kazan'-built Tu-16K-10 missile carriers used a different construction number system – the one introduced for the Tu-22. For instance, an example coded '15 Red' was c/n 1793014 – that is, batch 79, year of manufacture 1963, the first aircraft in the batch; the first and the last digits do not signify anything at all and were chosen arbitrarily to complicate c/n deciphering for the outsider. Again, unlike the prototypes, production Tu-16K-10s did not carry the c/n visibly.

Figures for Tu-16 production at plant No 22 are given in the table below:

The first production examples from Plant No 22 became the prototypes for various versions or were used as test-beds. Examples Nos 102 (c/n 3200102) and 103 (c/n 4200103) were converted to Tu-16A prototypes; example No 305 (c/n 4200305) was the Tu-16KS prototype; Tu-16 No 401 (c/n 4200401) was used for defensive armament trials, and Tu-16 No 105 (c/n 4200105) was used for testing the resistance of long-range radio communications to jamming. No 302 (c/n 4200302) was used for testing the interlocking of the undercarriage wheels with the wheel well doors; No 501 (c/n 4200501) became the Tu-16T torpedo bomber prototype, No 303 (c/n 4200303) was used for testing the SNAB-3000 homing bomb (see Chapter 3), No 504 (c/n 4200504) was used by OKB-156 for experimental work and No 505 (c/n 4200505) was supplied to Plant No 1 in the form of separate assemblies as a 'starter kit' to assist in launching production.

Tu-16 Production at Plant No 22

Version	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Tu-16	2	19	1	-	19*	3*	-	-	-	-	-
Tu-16A	-	45	189	103	57+46*	13*	-	-	-	-	-
Tu-16KS	-	6	10	29	23+23*	16*	-	-	-	-	-
Tu-16K-10	-	-	-	-	2	3*	2*	-	30	70	50
Tu-16E	-	-	-	-	-	38*	-	-	-	-	-

* examples equipped with a wing-to-wing IFR system

On 19th September 1953 the Soviet Council of Ministers issued directive No 2460-1017 ordering a stepping up of Tu-16 production, followed by a Ministry of Aircraft Industry order to the same effect on 25th September. Among other things, Plant No 1 at Kuibyshev-Bezymyanka was ordered to master the type. The first production bombers rolled off the Kuibyshev assembly line in the summer of 1954. Production there was greatly assisted both by the OKB and the by principal manufacturer of the type, Plant No 22. Of the ten examples assembled in Kuibyshev in 1954, three were built from completely knocked-down (CKD) kits supplied by Kazan'. Thus the first pre-production Tu-16 built by Plant No 1 (c/n 1880001, the first example in Batch Zero) was assembled entirely from the components of a Kazan'-built aircraft that would have been c/n 4200505 (as were c/ns 1880402 and 1880403), and the first seven examples built in early 1955 were similarly assembled from CKD kits supplied by Plant No 22.

The following versions of the Tu-16 were produced at Kuibyshev: the Tu-16 bomber, the Tu-16K-10, the Tu-16SPS, the Tu-16R, the Tu-16 Romb, the Tu-16E and the Tu-16 Yolka. In all, Plant No 1 produced 40 batches covering all versions of the Tu-16. Until 1955 each batch consisted of five aircraft; the number was increased to ten from batch 11 onwards and to 20 from batch 21 onwards. The c/ns of Kuibyshev-built examples are deciphered as follows: for instance, Tu-16R '12 Red' is c/n 1881809 – that is, Plant No 1, aircraft '88' (the Tu-16's designation at the OKB), batch 18, the ninth aircraft in the batch.

Tu-16 production at Plant No 1 in Kuibyshev is summarised in the table on the opposite page:

Like the machines produced in Kazan', some of the first Tu-16s produced at Plant No 1 were used as prototypes for later versions. The wing-to-wing IFR system was tested on Nos 001 (c/n 1880001), 101 (c/n 1880101) and 301 (c/n 1880301); Tu-16 No 202 (c/n 1880202) was used in developing the RBP-6 Lyustra (Chandelier) radar and the SRS-3 Romb-1 (Rhombus-1) electronic intelligence (ELINT) system, while Tu-16 No 302 (c/n 1880302) served as the prototype for the Tu-16R reconnaissance version (initially the experimental Tu-16R-1 and then the experimental Tu-16R-2).

On 2nd February 1955 the Council of Ministers issued directive No 163-97 followed on 1st March by MAP order No 127. These documents tasked Plant No 64 at Voronezh-Pridacha was ordered to begin series production of the Tu-16T torpedo-bomber for the Naval Air Arm, and the process of establishing series production there likewise proceeded with the active assistance and support of OKB-156 and the Kazan' factory. Apart from the Tu-16 and Tu-16T, Plant No 64 built a small batch of Tu-16 *Yolka* (with ASO-16 automatic systems). Production at Voronezh lasted until December 1957. Twenty-two batches (five aircraft each in the first 11 batches and ten aircraft each from batch 12 onwards) were built in Voronezh. The c/ns are deciphered as follows: for example, Tu-16LL '41 Red' is c/n 6401410 – that is, year of manufacture 1956, Plant No 64 (again the first digit is omitted for security reasons), batch 014, the tenth aircraft in the batch.

Tu-16 Production at Plant No 1

Version	1954	1955	1956	1957	1958	1959	1960
Tu-16	10	80	35	46*			
Tu-16 SPS (with SPS-1)	-	22	20	-	-	-	-
Ty-16 SPS (with SPS-2)	-	-	28	70	4*	-	-
Tu-16 Romb	-	-	5	-	-	-	-
Tu-16 Silikat (Fonar')	-	-	1	-	-	-	-
Tu-16R (with SRS-1 and SRS-3)	-	-	-	44*	26*	-	-
Tu-16 Yolka (with ASO-16)	-	-	-	42*	-	-	-
Tu-16E	-	-	-	4*	34*	13*	-
Tu-16K-10	-	-	-	-	-	17*	42*

* equipped with wing-to wing IFR system. Three Kuibyshev-built examples were experimentally fitted with the wing-to-wing system as early as in 1956

'26 Blue' (c/n 7203415) was a Soviet Navy/ Pacific Fleet Tu-16KSR-2-5. It is seen here at Vozdvizhenka AB, its home base, in company with a pair of Tu-22M3s hidden in earthen revetments and a pair of the mighty Tu-95RTs reconnaissance/over-the-horizon targeting aircraft. Yefim Gordon archive

Tu-16KS '62 Red' (c/n 7203730), the last aircraft in Kazan'-built batch 37, is pictured in the static park at the grand airshow which took place at Moscow-Domodedovo airport on 9th July 1967. The retracted radome of the Kobal't-M 360° search/target illumination radar is visible under the belly. The meaning of the additional number 7153 painted on the tail beneath the c/n is unknown. Yefim Gordon archive

Tu-16 Production in Voronezh

Version	1955	1956	1957
Tu-16	8	49	22*
Tu-16T	17	29	30*
Tu-16 Yolka (with ASO-16)	-	-	10*

* examples equipped for wing-to-wing refuelling

All three production factories were also involved in various refit and upgrades programmes and in producing spares for the Soviet Air Force's operational and maintenance units. An immense amount was done through the combined efforts of the Soviet Air Force and OKB-156 since, in addition to the 11 versions produced in series, there were several dozen types of modifications carried out on Tu-16 machines while in service.

A total of 1,507 Tu-16s (excluding the two Moscow-built prototypes and the static test airframe) were built at the three production factories: 799 at Plant No 22, 543 at Plant No 1 and 165 at Plant No 64. The tables list the quantities of the major versions and annual production of the Tu-16 at the three factories.

Some specialised versions were converted by operational Soviet Air Force and Soviet Navy units. For example, production Tu-16K-10 missile carriers were converted into Tu-16RM reconnaissance versions by Naval Air Arm units. Testbed examples were often converted by the organisations wishing to use them, either with the participation of OKB-156 or under its supervision. It would be impossible to give a precise list of all the versions and modifications since some aircraft were subject to more than one refit or upgrade. The following chapters, drawing on existing documents and archive material, contain more detailed information on the various versions of the Tu-16 as well as on a series of projects which never materialised.

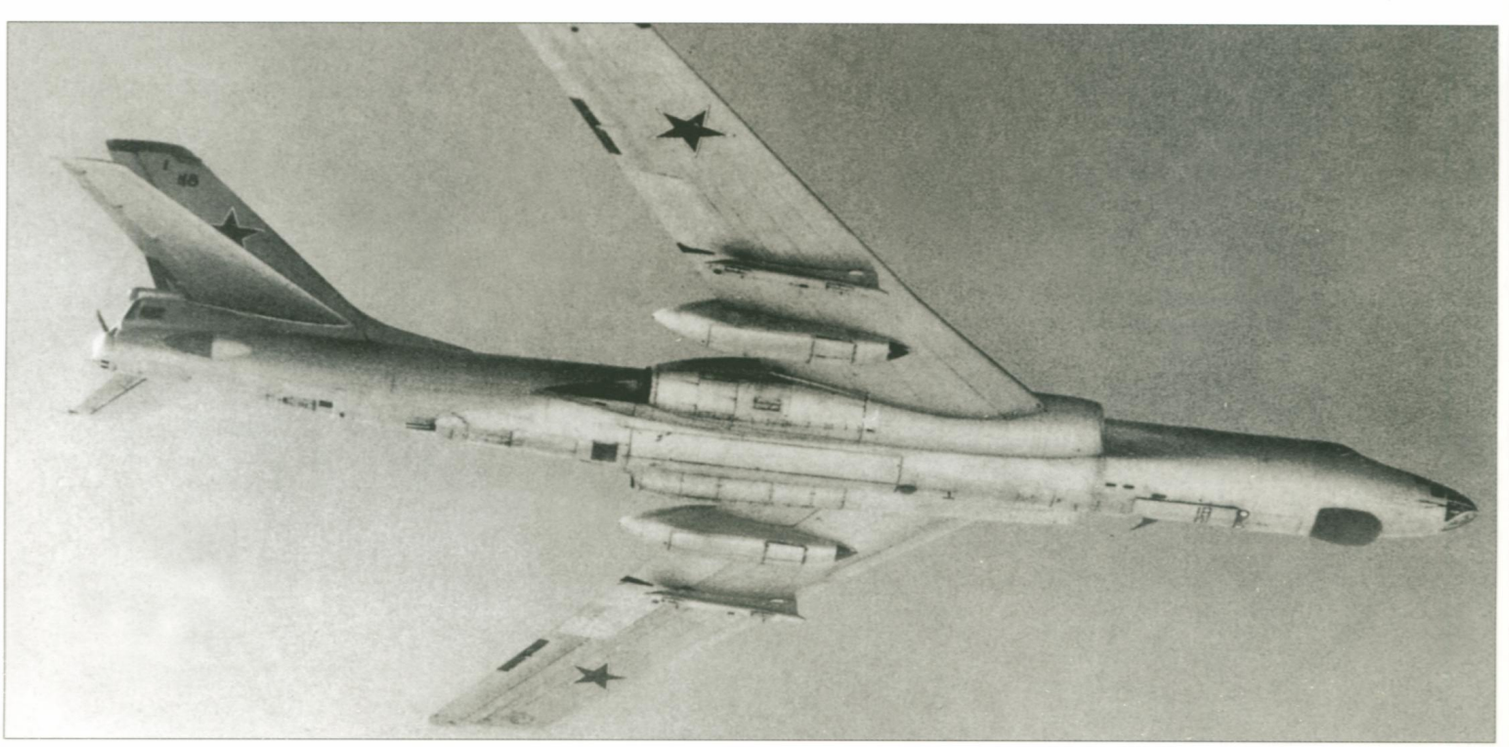
Tu-16 Versions Production Totals

Version	Plant No 22 Kazan	Plant No 1 Kuibyshev	Plant No 64 Voronezh	Total
Tu-16	44	171	79	294
Tu-16A	453	-	-	453
Tu-16KS	107	-	-	107
Tu-16K-10	157	59	-	216
Tu-16T	-	-	76	76
Tu-16R (with SRS-1 and SRS-3)	-	70	-	70
Tu-16 Romb	-	5	-	5
Tu-16E	38	51	-	89
Tu-16 Yolka (with ASO-16)	-	42	10	52
Tu-16SPS (with SPS-1)	-	42	-	42
Tu-16SPS (with SPS-2)	-	102	-	102
Tu-16SPS Silikat/Fonar'	-	1	-	1
Totals	**799**	**543**	**165**	**1507**

Tu-16 Production Totals

Year	Plant No 22 Kazan	Plant No 1 Kuibyshev	Plant No 64 Voronezh	Total
1953	2	-	-	2
1954	70	10	-	80
1955	200	102	25	327
1956	132	89	78	299
1957	170	206	62	438
1958	73	64	-	137
1959	2	30	-	32
1960	-	42	-	42
1961	30		-	30
1962	70		-	70
1963	50		-	50
Totals	**799**	**543**	**165**	**1507**

A Tu-16KSR-2-5 coded '18 Red' photographed from an escorting NATO fighter. Note the slits in the wing flaps to accommodate the fins of the KSR-5 missiles and the camera window immediately aft of the bomb bay. Yefim Gordon archive



Production and Experimental Bombers Special Purpose Versions

Tu-16 Long-Range Bomber (aircraft '88', 'order 882', *izdeliye* N)

The production Tu-16 bomber was based on the second prototype (the '88/2'), and new technological methods and structural materials had to be used in its construction The integral spar frames, essential to reduce the machine's structural weight, were produced at Kamensk-Ural'skiy, using large hydraulic presses brought from the Soviet occupation zone in Germany in 1948 together with their German operatives. The three Schliemann presses (two vertical presses delivering pressures of 30,000 and 15,000 tons and a horizontal press of 12,000 tons) had been assembled and brought back to full power by 1952, but were still almost idle due to lack of any orders from the aircraft industry. Designers were still thinking in outdated technological terms. The Tu-16 was, therefore, the first Soviet aircraft built in series to use large pressed parts. Soon after this, similar wing spars were pressed at Kamensk-Ural'skiy for the M-4 built at plant No 23 in Moscow; later orders included wings for the S-25 surface-to-air missile (SAM) system. By the end of the 1950s a hydraulic press of comparable power, but now built in the USSR, was installed at plant 1 in Kuibyshev and later used to produce parts for the R-7 intercontinental ballistic missile (ICBM). These advances put the USSR among the world's leading aero and space technologies.

As already mentioned, plant No 22 in Kazan' became the pilot production factory for the Tu-16 in accordance with Council of Ministers directive No 3193-1214 of 10th July 1952. Its experience in the large-scale production of Tu-4 bombers enabled it to implement production of an essentially new type of aircraft without undue problems – although some of the older parts of the factory had to be rebuilt. The launch of Tu-16 production was closely monitored by A N Tupolev, D S Markov and I F Nezval', head of OKB-156's Kazan' branch, and was based on the principles tried and tested with the Tu-4. While the two aircraft differed markedly, there *were* structural similarities.

There were still many new problems to be overcome. The swept-wing configuration with the jet engines tucked into the fuselage and fed by ducts through the wing spars demanded a special degree of care and accuracy from the assembly workers. The use of numerous large assemblies and integral parts meant the need for meticulous attention in their manufacture and assembly. A particular problem was caused by the delivery of imperfect wing spar frames. Close inspection was needed before these could be passed for assembly, and in some instances frames with deep incisions had to be scrapped. There were also many teething problems in fitting equipment, in particular the defensive armament and the PRS-1 Argon gun laying radar.

The first Kazan'-built production bomber (c/n 3200101) was rolled out on 29th October 1953, with production being extended to Kuibyshev in 1954 and to Voronezh the following year. The empty weight of the production bomber varied from 37,200 to 37,520kg (due to the variations in the bomb racks to suit different bomb loads). The Tu-16 was officially authorised for Soviet Air Force service by Council of Ministers directive No 1034-43 of 28th May 1954 amd MAP order No 355 of 4th June, with the Ministry of Aircraft Industry stipulating that a production machine should be available for checkout trials by GK NII VVS in September-October of that year. Checkout tests of the defensive armament system's components (the PS-35 sighting station with the VB-53 Argon radar) were carried out in July 1954, using Tu-16 c/n 4200401.

The Soviet Council of Ministers confirmed the following performance data for the Tu-16:

Crew	6
Max speed*	
at 6,250m	992km/h
at 10,000m	938km/h
Service ceiling / time to reach it †	12,900m / 31 mins
Maximum range ‡	5,760km
Take-off run with a 71,560-kg TOW	1,900m;
Landing run with a	
landing weight of 44,000kg	1,655kg
Bomb load	
normal	3,000kg
maximum	9,000kg

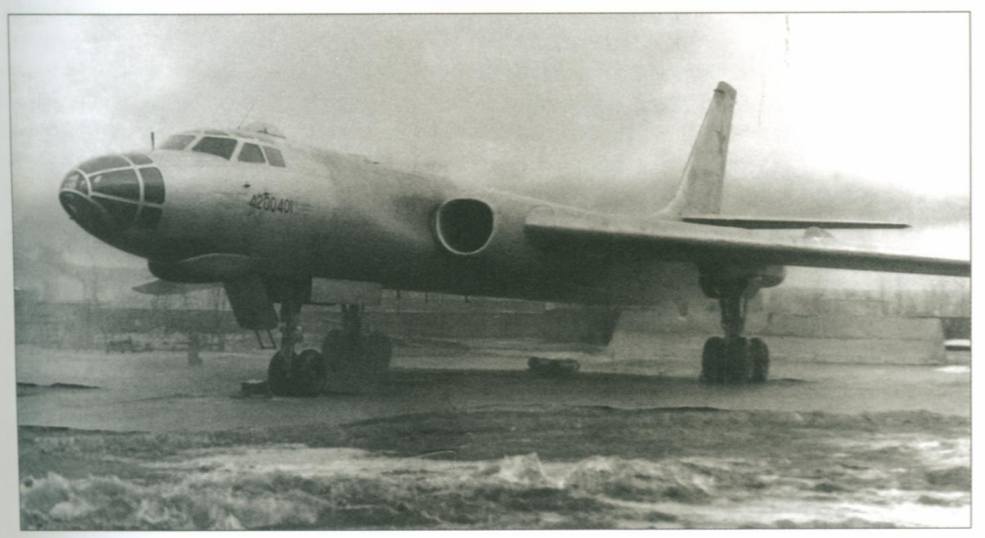
Cannon armament

One fixed forward-firing 23mm cannon with 100 rounds
Dorsal turret with 2 x 23mm cannon (250rpg)
Ventral turret with 2 x 23mm cannon
(normally 250rpg, but up to 350rpg possible)
Tail turret with 2 x 23mm cannon
(normally 350rpg, but 500rpg possible)

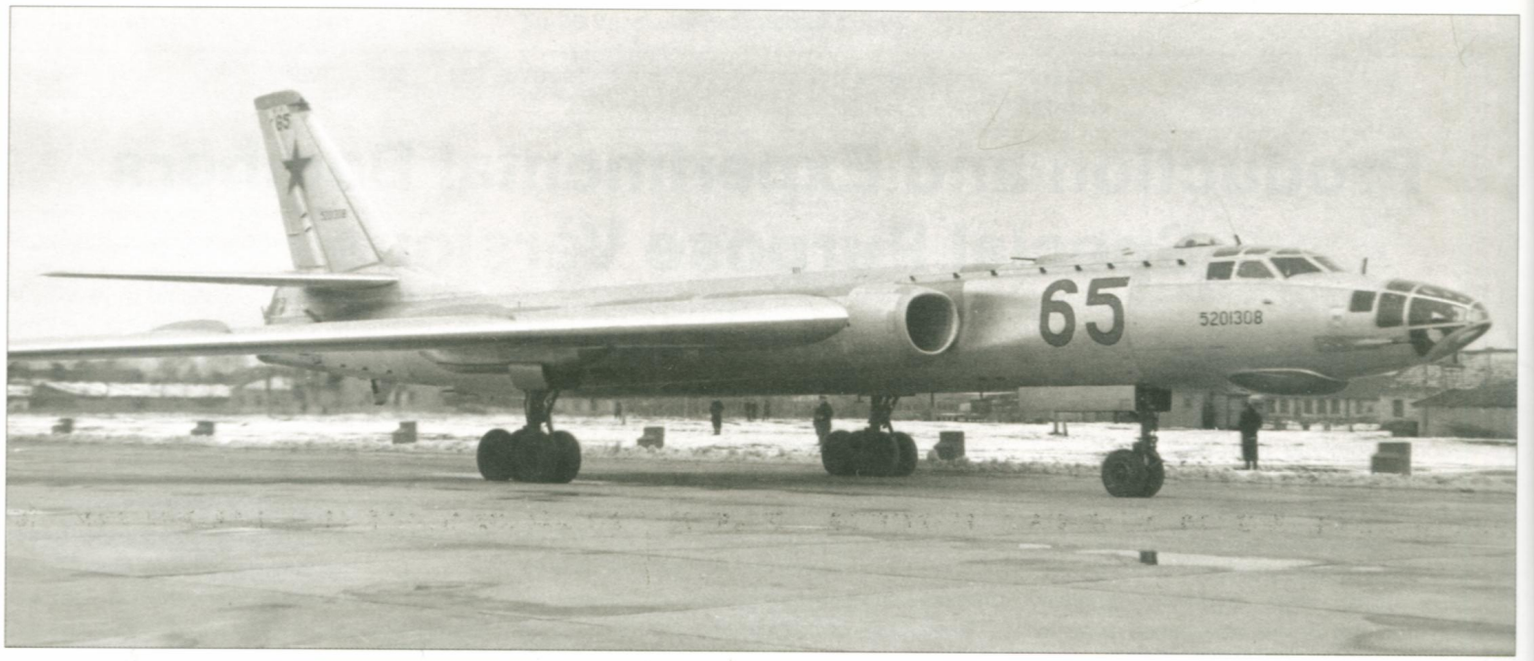
* in level flight at max power and a normal AUW of 55,000kg
† at nominal power and normal all-up weight
‡ at optimum cruising speed with a 72,000-kg TOW ('hi-hi-hi' mission profile) and a 3,000-kg bomb load

MAP ordered a production aircraft (c/n 4201002) to be modified to increase its range. Its maximum overload weight of 75,800kg included greater fuel tankage. Monitored trials by NII VVS of the aircraft's take-off and landing characteristics and range with the overload weight given above yielded the following results:

- With the AM-3 engines at take-off thrust and flaps at 20°, lift-off speed increased to 288km/h, the take-off run to 2,180m, and the take-off distance to 3,375m
- With a bomb load of 300kg, ammunition 700kg and fuel load 34,263kg a range of 6,430km was attained. The service range (with 5% fuel reserves) was 5,970km



An uncoded Tu-16 (c/n 4200401) representative of the baseline bomber version sits parked at the Irkutsk Military Aviation Technical School under dreary skies in the early spring. Note the concrete blast deflector behind the aircraft.
Viktor Kudryavtsev archive



After these trials, Tu-16 c/n 4201002 was used as the 'standard-setter' for production examples for 1955.

In 1954 production was initiated at Plant No 1 at Kuibyshev. Tests of the first production example (c/n 1880001) demonstrated that a large aircraft like the Tu-16 did require power-assisted controls, and that, despite its weight reduction, the Tu-16 was of robust construction. These conclusions resulted from a test flight on 28th September 1954 in which factory test-pilot Molchanov was instructed to determine the machine's G limits. At an altitude of 9,000m the machine was put into a dive, pulling of 3.2 Gs when recovering from the dive; however, the mission objective was to achieve a G load of 3.47. When the pilots reached a critical angle of attack, the aircraft began to vibrate, then stalled and went into a tight spiral. The captain ordered the crew to eject, and was the first to do so. However, the young co-pilot A I Kazakov stayed with the aircraft and tried to recover from the spin, but could not do so due to the high control forces as speed increased. A G load of 4.2 was reached and the destruction of the aircraft and its crew seemed imminent. But fortune was on Kazakov's side: the G force wrenched the undercarriage legs loose, forcing them into extended position, and the extra drag slightly reduced the speed. By pulling the control column back with a force of no less than 100kg Kazakov recovered from the spin just before reaching the ground. The aircraft remained, to all intents and purposes, undamaged and a month later Kazakov was awarded the Hero of the Soviet Union title. The strength of the aircraft evoked real interest, since it had significantly exceeded its G limit and still stayed in one piece.

'65 Red' (c/n 5201308), another example of the 'conventional' Tu-16 bomber (as distinct from the nuclear-capable Tu-16A). The use of such large tactical codes on the forward fuselage was later discontinued. Note the early-model 'towel rail' aerial on the forward fuselage. This aircraft was later transferred to another unit and recoded '17 Red'. Yefim Gordon archive

One more early-model Tu-16 bomber, '70 Red' (c/n 5201406), taxies out for take-off past a trio of Lisunov Li-2 transports. Yefim Gordon archive

From the second aircraft of the third Kuibyshev-built batch (c/n 1880302) onwards the forward-hinged quasi-triangular forward segments of the mainwheel well doors were replaced by twin lateral doors. This eliminated vibration in the undercarriage fairing caused by the stalled airflow from the door when the legs were lowered.

This rear view of Tu-16 '32 Blue' (c/n 5201510) taxying across a wintry airfield shows the deployed flaps and the tail guns in the fully elevated position. Note that the rear fuselage is black with soot; the AM-3 was a smoky engine.
Yefim Gordon archive

The last of three production factories, Plant No 64 in Voronezh, rolled out its first production Tu-16 (c/n 5400001) in May 1955.

The first production bombers entered service with the Long-Range Aviation (DA – ***Dahl'****nyaya avi****ah****tsiya*) and the Naval Air Arm (AVMF – *Avi****ah****tsiya vo****yen****no-mor****sko****vo* ***flot****a*) in early 1954. The Air Force and the Navy received the 294 bombers built at the three factories over the course of six years in roughly equal numbers. In the mid-1950s 114 Tu-16s were converted into inflight refuelling tankers at the production factories, and from 1957 90 were equipped to receive inflight refuelling (ZA). Subsequently some Tu-16s were converted into probe-and-drogue tankers to refuel the supersonic Tu-22. A number were also converted into various testbeds from 1954 onwards. By the early 1980s only a small number of dedicated bomber versions of the Tu-16 remained in service.

Over its many years of service, the basic aircraft was also improved and modernised with an increase in its take-off weight to 77,150kg (with an empty weight of 37,200kg). The RD-3M engines and their advanced versions replaced the original AM-3s, the mission equipment was updated and an ASO-16 passive ECM system fitted to counter enemy radar. Many other systems were also changed.

The bomber version remained the basis for all subsequent versions of the Tu-16. From 1958 onwards it was supplied to China, where licence production was later inaugurated.

Some of the Tu-16s remaining in service at the end of the 1970s were equipped the latest ECM systems, in particular the Siren' (Lilac, pronounced *see****ren'***), SPS-4M and the like. ('order 2615' and 'order 691'). (SPS = ***stah-n****tsiya po****mekh****ovykh sig****nah****lov* – lit. 'interference signal emitter'.) Machines were modified to take the 'Rogovitsa' [Cornea] flight system. Some machines which began life as dedicated bombers remained in this form throughout their service lives. Several remained at the DA's 43rd Combat & Conversion Training Centre at Dyagilevo airbase near Ryazan' and with the training regiments of the Chelyabinsk Military Navigator College.

The appearance of the new jet bomber in the Soviet Union did not go unnoticed in the West. NATO's Air Standards Co-ordinating Committee (ASCC) allocated it the reporting name *Badger*, and subsequently *Badger-A* as the first production model.

Tu-16A Nuclear-Capable Bomber (aircraft '88A', 'order 191', *izdeliye* NA)

The Tu-16A carrying a free-fall atomic bomb was the first Soviet nuclear weapons delivery system to see service in large numbers. In production it was referred to as 'order 191', and in operational service as 'aircraft 88A' or *izdeliye* NA (for ***ah****tomnyy* – nuclear; in this case, nuclear-capable). Unlike the Tu-16, the Tu-16A had a bomb bay with electrical heating, insulation and a temperature-regulation system to enable it to carry nuclear weapons, and the aircraft was provided with special protection from the flash and shock wave of a nuclear explosion. A special system for preparing and releasing the nuclear weapon was also fitted.

Production of the Tu-16A began in 1954 at plant No 22. Before production ceased in 1958, 453 had been built, of which 59 were equipped with an IFR receptacle under the port wingtip in 1957-58 as the Tu-16A (ZA). This modification accounted for almost a third of all Tu-16s built, and was the largest version to see series production. Like the Tu-16, the Tu-16A served in approximately equal numbers with the DA and the AVMF. During the 1960s, 155 Tu-16A bombers were converted to carry KSR-2 and KSR-11 ASMs. Several dozen Tu-16A were still in squadron service in the early 1980s.

Work on producing a version capable of delivering nuclear weapons began in mid-1953. Two conventional Tu-16 bombers were modified after the completion of design work in November 1953 and submitted for testing by a special organisation based at Bagherovo airfield near Kerch on the Crimea Peninsula. This unit exercised overall responsibility for equipping the Soviet Army with nuclear weapons under its head, General Chernorez, who was a highly informed specialist in the field of nuclear and thermonuclear weaponry. The first two Tu-16 bombers to be converted to 'order 191' standards were the second and third Kazan'-built production examples (c/ns 3200102 and 4200103). The adaptation work was completed in 1953, and series production of the Tu-16A began with c/n 4200502 (although some sources indicate that the first production Tu-16A was c/n 4201301).

In squadron service the Tu-16A served both as a nuclear weapon carrier and a conventional bomber, and was equipped with an RBP-4 radar, an OPB-11R or OPB-11RM optical bombsight, a PKI reflector sight, PS-53VK, PS-53BL, PS-53BP and PS-53K optical sighting stations, a PRS-1 gun ranging radar, a Sirena-2 radar warning receiver, an SPS-5M active ECM system, an A-711 (with A-713) LORAN system, a KI-12/GPK-52/DIK-46M flux-gate compass, an NI-50B navigational display, an RSBN-2S Svod (Dome) SHORAN, a DISS-1 Doppler speed and drift angle indicator, an ARK-5 automatic direction finder, an RV-17M high-altitude altimeter, an RV-2 low-altitude altimeter, an IAS-1M/AK-53M/ DAK-2 stellar-solar orientation device, an AP-5-2M or AP-6E autopilot, an SP-50 blind landing system, an A-326 formation flight system, RSIU-5B and R-832M command radios, a 1-RSB-70M communications radio with a US-9 receiver and a R-851 crash (survival) radio. Three auxiliary power panels were provided in the navigator's, second pilot's and navigator/radio operator's crew positions.

The Tu-16A could carry the same bomb, mine or torpedo weapon load as the Tu-16, but was also able to carry the MVD6-16 (or MVD6-16M), one of the five types of atom bomb at the disposal of the DA. The version of the Tu-16A capable of carrying mines was produced as 'order 699'.

Atomic bombs were dropped using an OPB-11R or OPB-11PM bombsight linked to the RBP-4 bomb-aiming radar and the AP-5-2M or AP-6E autopilot. As already mentioned, to keep the delicate control system of the nuclear munition operational the bomb bay temperature was maintained at +20°C, using four *izdeliye* 107 electric heaters, four air temperature regulators, four powered fans and a temperature control system.

The aircraft, crew and equipment were protected from the heat and flash of the nuclear explosion in the following ways:

- by sealing or narrowing the gaps on the aircraft's exterior (hatch covers, doors and the like), using overlapping tape
- by fitting blinds to glazed areas which could be closed or put in place before the bomb was dropped
- by encasing some equipment and wiring in insulating materials
- by applying special white reflective paint to the underside of the aircraft (this was known as the 'atomic' colour scheme)

When the Tu-16A entered service its empty weight of 37,700kg was 185kg greater than the basic bomber's. In the late 1950s all operational Tu-16A bombers were modified to ensure greater resistance to the nuclear flash, with those areas of the metal skinning most exposed to the flash made as resistant as possible. From 1962 onwards the aircraft was fitted with the ASO-16 chaff dispenser. Since the Tu-16A had no external differences from the baseline bomber (apart from the white undersides), it was likewise referred to by NATO as the *Badger-A*.

The data below refer to the Tu-16A with two RD-3M-500 engines (each providing a maximum thrust of 9,500kg) in the closing days of its service career:

Empty weight	39,720kg
All-up weight	
normal	75,800kg
maximum	79,000kg
Maximum bomb load	9,000kg
Maximum speed *	
up to 500m	670km/h
at 6,250m	890km/h
at 10,000m	960km/h
Maximum permissible Mach number	0.9
Service ceiling with a TOW of 62,000kg	12,800m
Service range †	5,800km

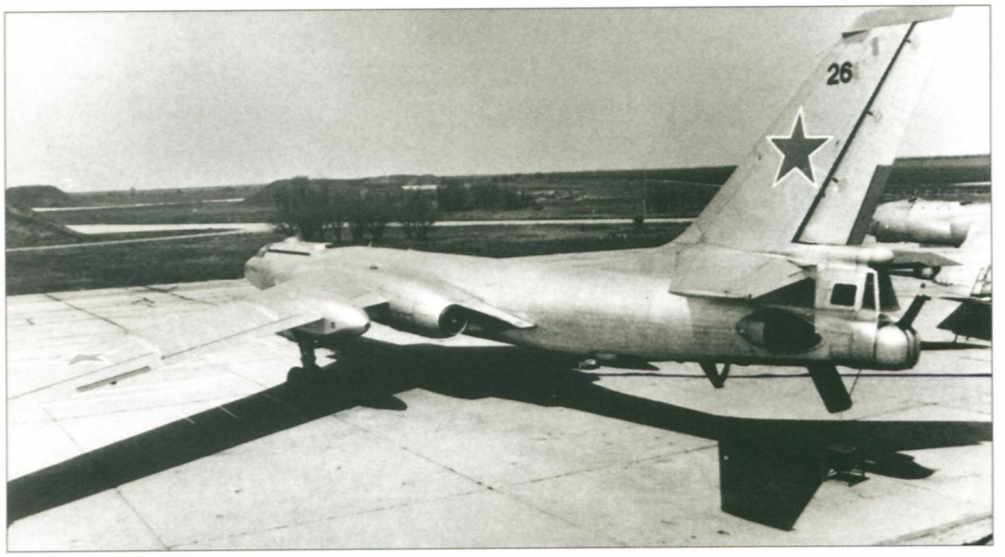
* at full power and an all-up weight of 55,000-70,000kg
† at optimum altitude, releasing bomb load at the midway point

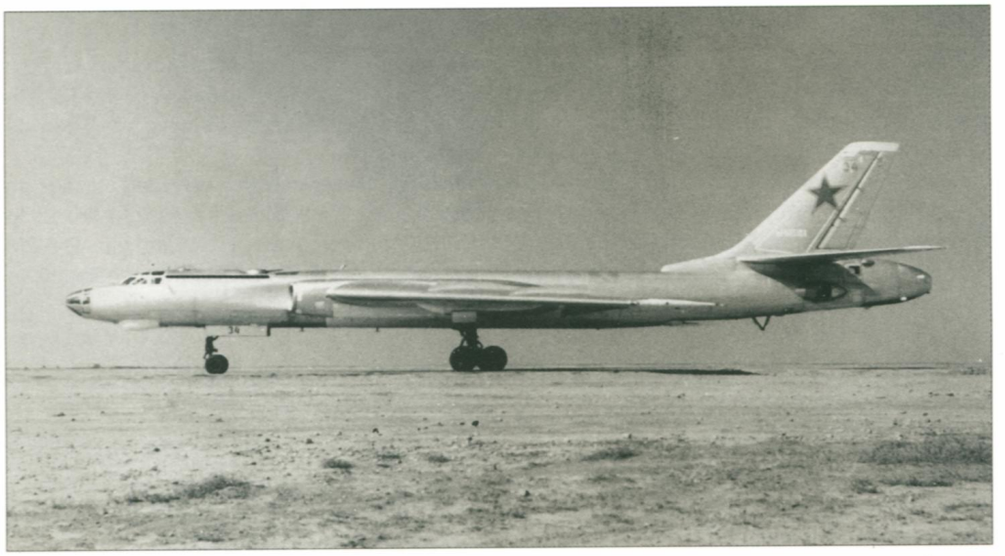
Tu-16A Nuclear-Capable Bomber (aircraft '88A', 'order 684/1')

Experience gained in local conflicts at the end of the 1960s stimulated a widening of the bomber's tactical capabilities. A special variant able to carry a large number of small bombs weighing between 5 and 500kg was produced as 'order 684/1'. The internal bomb load remained at 9 tons, but the number of externally carried bombs was increased (between 16 and 24 FAB-100s and FAB-250s; between 12 and 18 FAB-500s). The first example to be modified in this way was Tu-16A c/n 7203829.

Tu-16A Nuclear-Capable Bomber (aircraft '88A', 'order 2624')

In the late 1960s and early 1970s a small number of Tu-16A bombers had the DK-7 tail turret and PRS-1 gun-laying radar replaced by an SPS-100 Rezeda (Mignonette, pronounced *reze**dah***) jammer in a characteristic conical fairing with flattened sides. This ECM fairing, which was also used on some other Tupolev types, was known as UKhO (*oonifi**tsee**rovannyy khvosto**voy** ot**sek*** – standardised tail compartment). Additionally, an SPS-5 jammer was installed in the avionics bay. Such aircraft were referred to as 'order 2624'. The first such aircraft was '34 Red' (c/n 7203514).

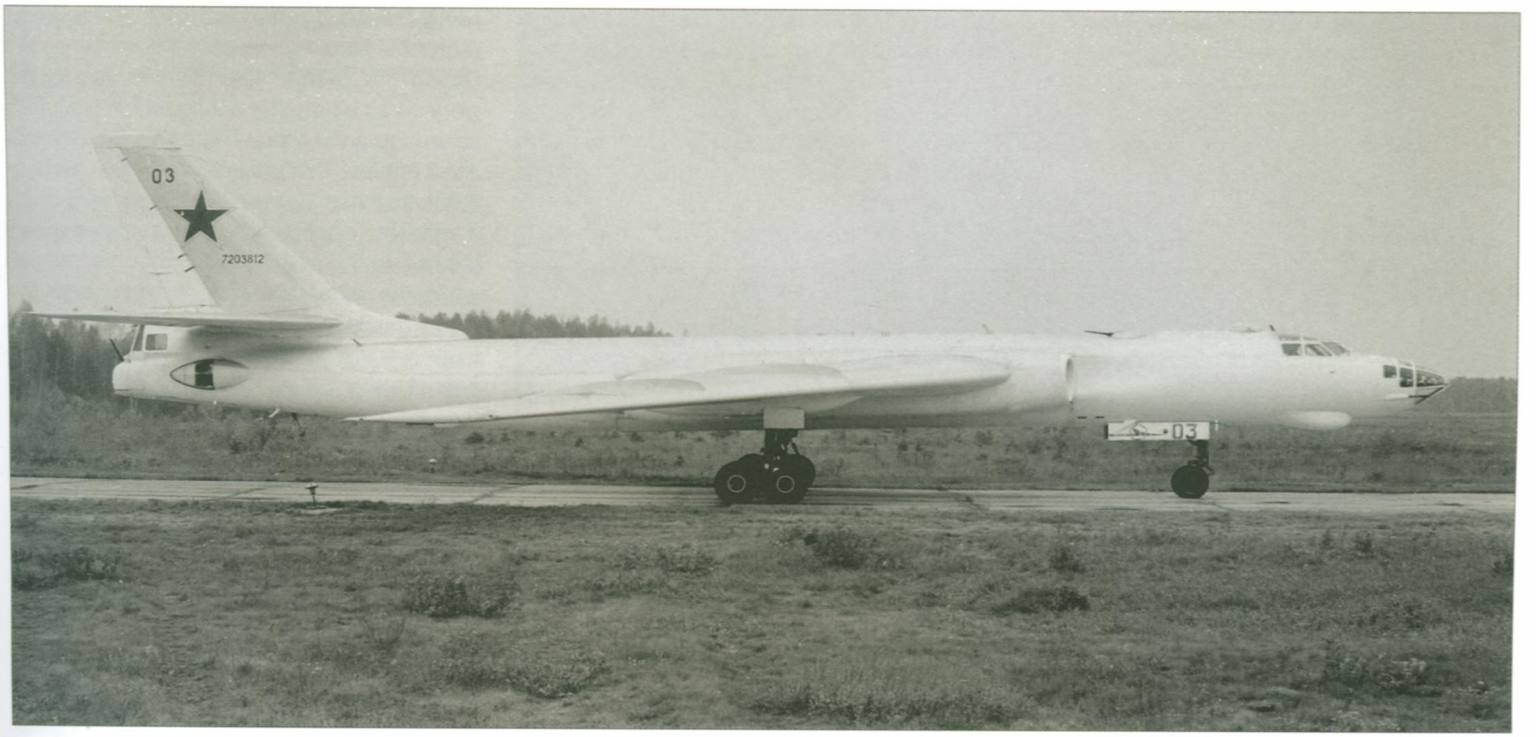




In the latter days of the Tu-16's service career the construction number was no longer carried visibly, as demonstrated by '26 Blue'. Note that all trim tabs are painted red.

A Tu-16 seen from the dorsal observation/ sighting blister of a sister ship flying in echelon starboard formation.

Tu-16A '34 Red' (c/n 7203514) was not a specialised ECM variant; it was equipped for ECM protection during group operations, featuring SPS-100 Rezeda and SPS-5 jammers in a UKhO tail fairing supplanting the tail turret. It is seen here during trials. This variety of the 'A was known as 'order 2624'. All Yefim Gordon archive



Above: **A magnificent view of Tu-16A '03 Red' (c/n 7203812). The aircraft shows off the white undersides and rudder characteristic of most (though not all) examples of this nuclear-capable bomber; the reflective white paint was meant to minimise the effects of the nuclear flash on the aircraft. Note the 'Excellent aircraft' badge, a maintenance award, on the nose gear door.** Yefim Gordon archive

Tu-6A Nuclear-Capable Bomber (aircraft '88A', 'order 657')

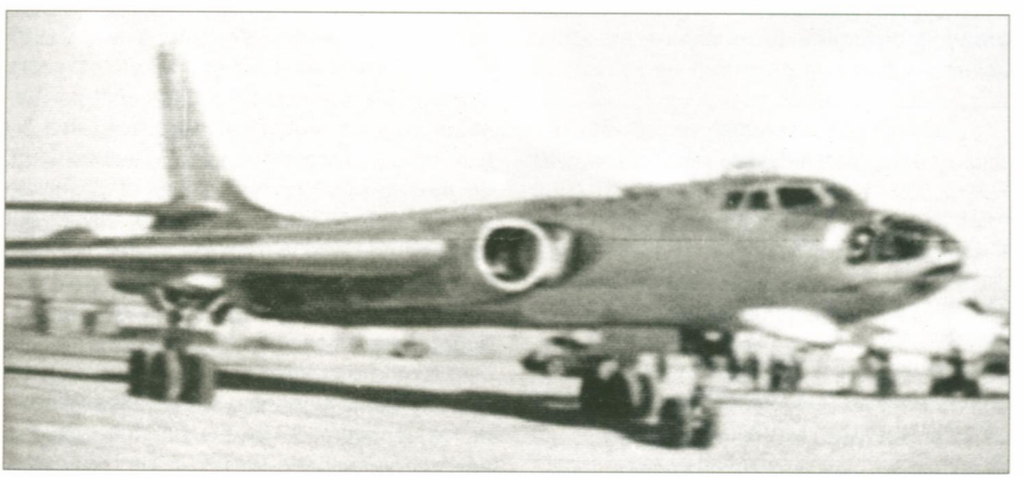
The Tu-16A was again upgraded in the 1970s when 'order 657' brought revisions to the electrical wiring for the nuclear bomb release system and enhanced protection for the crew.

Tu-16A Nuclear-Capable Bomber (aircraft '88A', 'order 260')

Among other versions with slightly revised equipment and armament were a number of Tu-16A bombers fitted with a 'Rubin' radar combined with an OPB-112 optical bombsight as 'order 260'.

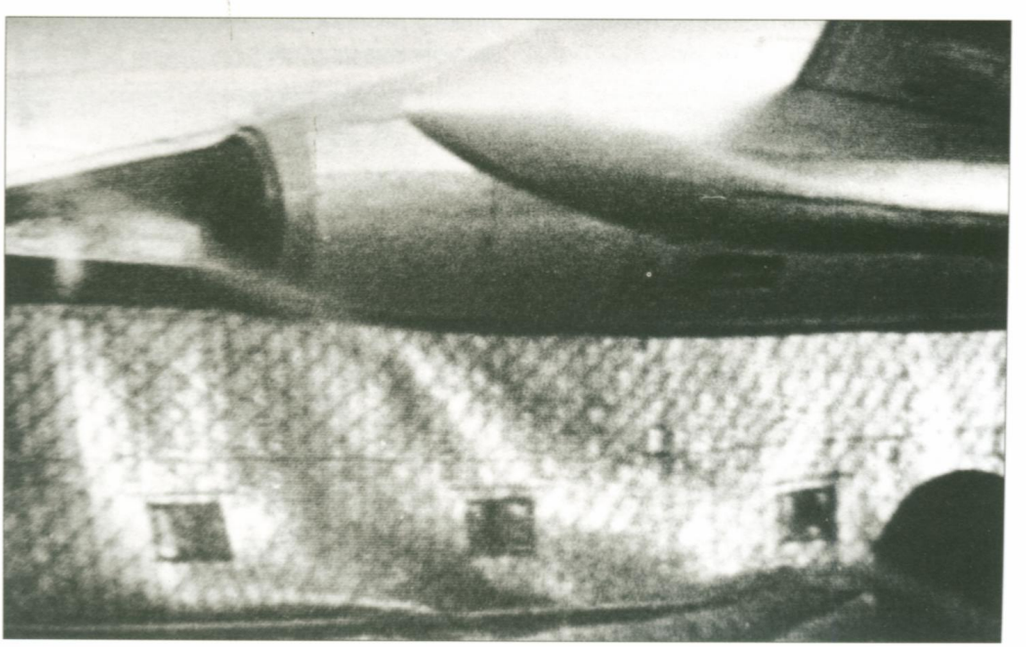
Tu-16A Experimental Versions (Tu-16V) ('order 212', 'order 468')

In parallel with development of the Tu-95V as a carrier for the 100-megaton hydrogen bomb (known as *izdeliye* 'V', or 'Vanya', or 'Ivan'), Tu-16 c/n 4200503 was similarly adapted in 1956 pursuant to CofM directive No 357-228 of 17th March 1956 and MAP order No 184 of 29th March. In production this variant was known as 'order 212'. Later two further production examples of the Tu-16 were modified to 'V' standard ('order 468'). These machines are sometimes referred to as the Tu-16V by analogy with the Tu-95V; the V in all these cases was probably derived from *vodo**rod**naya **bom**ba* – hydrogen bomb. They were used for testing Soviet nuclear and thermonuclear weapons.



Above: **Tu-16A c/n 4200503 was modified in 1956 as the sole Tu-16V capable of carrying a hydrogen bomb.** Yefim Gordon archive

Below: **Close-up of the heavy curtain erected around the Tu-16V's bomb bay when the hydrogen bomb was being loaded. This was probably meant to conceal the bomb from those who were not supposed to see it, but may be a heat insulation curtain as well.** Yefim Gordon archive



Tu-16B Experimental Long-Range Bomber

On 28th March 1956 the Council of Ministers issued directive No 424-261 followed by MAOP order No 194 on 6th April. These documents ordered OKB-156 to develop a version of the Tu-16 powered by Zoobets M16-15 (RD16-15) turbojets developed by the Rybinsk Engine Design Bureau (RKBM), each with a take-off thrust of 11,000kg. These were to give the aircraft a range of 7,200km and a maximum speed of 1,030-1,050km/h. Two examples were to be ready for State acceptance trials in the first quarter of 1957. 28th May 1956 saw the appearance of MAP order No 295 instructing OKB-156 to supply the necessary conversion documentation to plant No 22 in Kazan' in preparation for series production before 1st July. Plant No 22 itself was ordered to produce two prototypes with the new engines, one to be ready for manufacturer's tests in October and the second in November 1956, while OKB-16 was to supply four RD16-15 engines with a life of 200 hours in September. Two versions of the resulting Tu-16B were proposed, one with additional external fuel tanks and one without. The estimated data for the two versions are given below:

	no external fuel tanks	with external fuel tanks
Wing area	165m²	184m²
Empty weight	38,100kg	39,440kg
Take-off weight	76,800kg	90,200kg
Maximum range	-	9,780km
Operational range		
no in-flight refuelling	7,200-7,500km	8,950km
1 in-flight refuelling	10,000-10,500km	11,900km
2 in-flight refuellings	13,200km	15,200km

The Tu-16B prototype was modified from a production machine (c/n 6203330) built in Kazan'. Testing at LII got under way in March 1957, initially with M-16-15 and then with RD16-15 engines which had a longer service life. The second prototype Tu-16B underwent trials at GK NII VVS until 1961. Outwardly the Tu-16B differed only in the shape of the engine fairings. Unlike the AM-3, which was started by a so-called turbostarter (a small gas turbine engine spinning up the main engine's spool), the M-16-15 (RD16-15) had electric starting; hence additional DC batteries had to be carried and the engine fairings lacked the usual exhaust ports for the turbostarters. The Tu-16B was to offer vastly improved performance – especially range – thanks to its more powerful and fuel-efficient engines and greater fuel load. It was planned to use it as an intercontinental bomber but, although the basic objectives were achieved and the engines proved reliable and trouble-free, the cutbacks in the Soviet bomber force meant that neither the Tu-16B nor its engines entered series production.

Along with the Tu-16B project, OKB-156 worked on a number of others relating to the bomber's engines; these included an attempt to equip the RD-3M with thrust reversers (on both the Tu-16 and the Tu-104) and the use of jet-assisted take-off (JATO) boosters to reduce the take-off run when the bomber was fully loaded. None of these were adopted for production machines. Later projects in 1965 included replacing the RD-3M-500 with more fuel-efficient Kuznetsov NK-8-2 or NK-8-4 turbofan engines, but these were frustrated by problems with modifying the engine housings. In the mid-1970s the issue of installing Solov'yov D-30P turbofans was raised but received no backing from the Soviet Air Force Command.

The 'inflexible' character of the bomber's engine installations had been a matter of concern for the aircraft's designers for some time. As early as the beginning of the 1950s an alternative configuration for the bomber included new wings featuring leading-edge root extensions (LERXes) with 45° leading-edge sweep at the roots; the leading edges incorporated slot air intakes similar to those of the British V-bombers. The engine fairings were to be under the wing trailing edge close to the fuselage. Such a layout would have provided far more options on the type of engines fitted as the bomber was upgraded.

Long-Range Bomber with TR-3F Engines (aircraft '90/88' project)

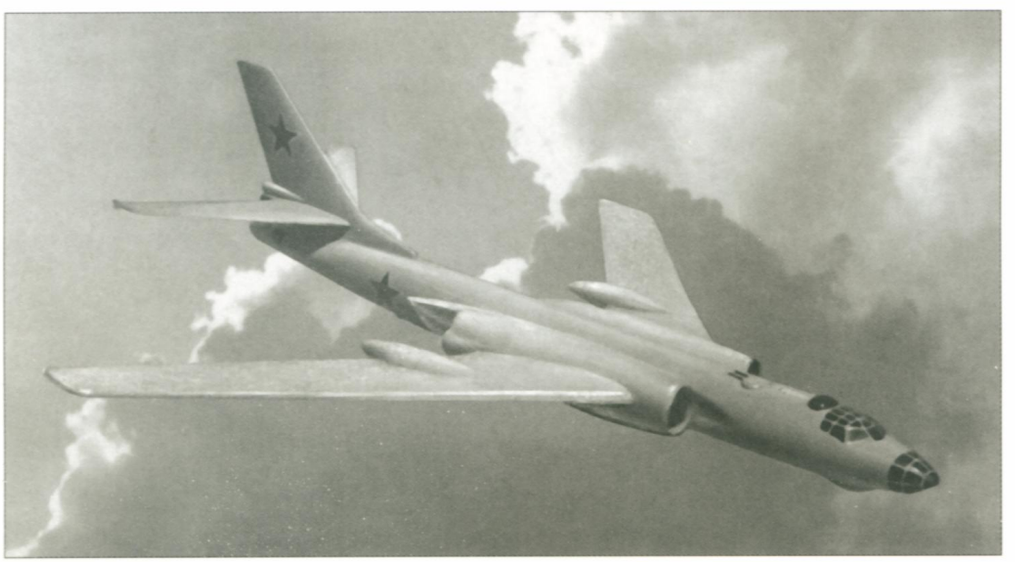
During the design work on the '88', project work on an alternative configuration continued as an insurance policy in case of problems with AM-3 engine. This project, the '90/88', had four 5,000-kg thrust Lyul'ka TR-3F engines, but with a different configuration. Two engines were located in the same positions as on the '88', while the other two were carried under the wings between the flaps and ailerons. Two versions were prepared: one had main gear fairings like the '88' while on the second version the main gear units retracted into fairings blended smoothly with the wing engine nacelles. In both cases the main undercarriage leg had twin wheels, and single-wheel outriggers were fitted to the wingtips (in a similar way to that originally proposed for the '88'). The fuselage was virtually identical to the Tu-16. Further development was terminated once the success of the Tu-16 was assured.

Long-Range Bomber with TV-12 Turboprop Engines (aircraft '90' project)

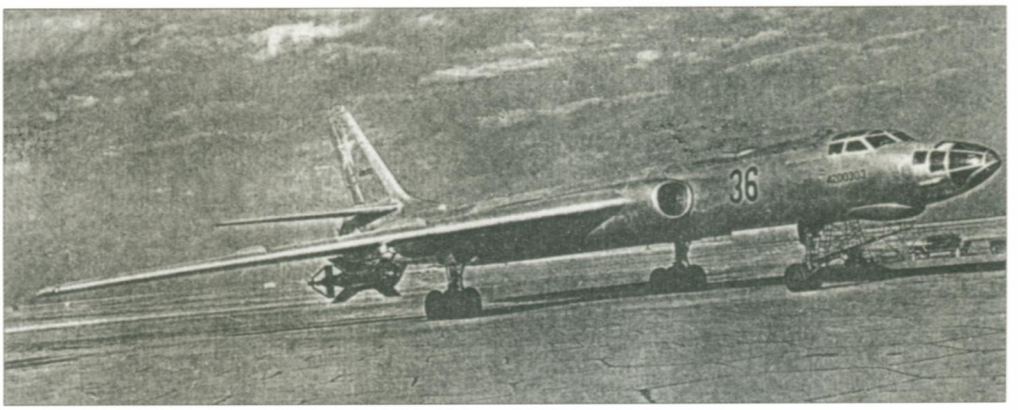
In 1954 OKB-156 engineer Sergey M Yeger proposed a version of the Tu-16 powered by two 12,000-ehp Kuznetsov TV-12 turboprops (known as the NK-12 in production form and already fitted to the four-engined Tu-95 bomber). The turboprop derivative of the Tu-16 was designated 'aircraft 90'. Yeger's project called for the wing of the '88' to be modified, the air intakes eliminated, and the new engines mounted on the wings between the flaps and ailerons in fairings which also housed the main undercarriage legs. The more fuel-efficient turboprop engines were seen as a means of extending the bomber's range, but the associated redesign of the wings, undercarriage and fuselage looked set to be protracted; also, the Soviet Air Force was satisfied with the performance of the Tu-16 with AM-3 engines. The project was therefore shelved, although a version of the Tu-104 airliner fitted with either NK-8 turbofans or Kuznetsov TV-2F turboprops was later considered as project '118'.

Long-Range Bomber with VD-5 Engines (aircraft '97' project)

In the mid-1950s OKB-156 explored the idea of converting the Tu-16 into a supersonic bomber (*izdeliye* '97'). Two Dobrynin VD-5 afterburning turbojets designed by OKB-36 were to be fitted, together with a new wing swept back 45° at quarter-chord. These measures were designed to increase the bomber's top speed by at least 150-200km/h. Work on designing entirely new supersonic long-range aircraft made the project unviable.



An artist's impression of the projected '103' bomber of the Tu-16. The greatly enlarged engine nacelles housing vertically paired turbojets are clearly visible. Tupolev JSC



Tu-16 '36 Black' (c/n 4200303) was modified for testing the SNAB-3000 Krab homing bomb; two such bombs were carried on special underwing pylons. Tupolev JSC

Long-Range Supersonic Bomber with VD-7 or AM-13 Engines (aircraft '103' project)

One of the last endeavours to exploit the proven success of the Tu-16 was the projected '103' long-range supersonic bomber. The wing sweep was to be increased to 45° and four Dobrynin VD-7 or Mikulin AM-13 afterburning turbojets fitted; the engines were to be paired vertically *à la* English Electric Lightning and housed in enlarged fairings. Further investigation of the project, however, indicated that the machine would not be able to reach supersonic speed in its existing configuration even with twice the engine power. However, the '103' did serve as the precursor to the work on the '105' truly supersonic bomber which ultimately emerged as the Tu-22 (in 1954 the possibility of using the Tu-16 for a first essay in this direction was examined).

Experiments with Guided Bombs

The Tu-16 Chaika

Soviet development work on guided bombs, initially based on World War Two German types such as the Fritz X, for tactical and long-range bombers began in the early 1950s. The Tu-16 was seen as a suitable delivery vehicle for the 5,100-kg UB-5 Condor (aka UB-5000F; UB = *oopravl**ya**yemaya **bom**ba* – guided bomb) with a 4,200-kg warhead or the 2,240-kg UB-2F (UB-2000F) Chaika (Seagull) with a 1,795-kg warhead. Radio control or television guidance systems were used. The Tu-16 equipped to carry a guided bomb was fitted with a KRU-UB radio control transmitter, the operator either following the course of the marker flare attached to the bomb through an OPB-2UP optical sight or using images transmitted to a monitor screen from a TV camera (a 'bomb's eye view') to make course corrections through the linked radio control system. The latter method proved more accurate and less reliant on weather conditions. The bombs were carried under the fuselage or under the wings.

A small number of Tu-16 bombers were equipped with the 4A-22 Chaika system which controlled the UB-2F guided bomb against small but important targets such as railway bridges, storage depots and administrative buildings from high altitude. Two UB-2F bombs were carried under the wings on special pylons and the bomber was fitted with an electric system for arming and guiding the bomb. The system could only be used in good visibility conditions when both the bomb and the target could be observed through the special OPB-2UP periscopic synchronised sight used for dropping free-fall and guided bombs in level flight. This automatically signalled proximity to bomb release, the time when the bomb bay doors were to be opened, and the moment of release. Guidance was effected through the sight by a juxtaposition of the bomb's image with an indicator registering the angles of divergence derived from calculating the bomb's trajectory and generated by a special computer.

In-flight control by the bombardier was effected by a 4A-N1 data link system transmitting on three wavebands simultaneously to frustrate jamming. The bomb's receiver passed the signals to the AP-59 autopilot which activated the bomb's guidance mechanism and made the necessary corrections to keep the bomb level. The bomber's height dictated the required speeds for releasing the bomb, and these varied between 550km/h at 5,000m and over 900km/h above 6,500m. As the bomb's speed was lower than that of the bomber, the pilot was obliged to pull his machine up and lose speed so that both the bomb and its target remained visible. The UB-2F (UB-2000F) had a high-explosive warhead (F = *foo**gahs**naya* – high-explosive), but the use of the UB-2000B armour-piercing version (B = *brone**boy**naya* – armour-piercing) was also envisaged.

During the latter years of the 1950s the improved Chaika-2 (with infra-red homing) and the Chaika-3 (with passive radar homing for use against enemy radar and ECM sites) were developed, although only the 4A-22 Chaika was actually tested and accepted for operational use in December 1955. The UB-2F was the first Soviet guided bomb. Tests results showed that only two or three such bombs were needed to hit a target measuring 30 x 70m as against 168 FAB-1500 conventional free-fall bombs.

Tu-16 Condor Guided Bomb Carrier ('order 251')

Preliminary tests of the UB-5 (UB-5000F) Condor guided bomb were carried out using the Tu-4. The Condor was intended for use against large surface ships and was essentially an enlarged Chaika with a high-explosive warhead. Two versions were developed, one using line-of-sight radio command guidance (like the Chaika) and the other TV guidance. The radio command system was used during tests with the Tu-4, but its accuracy proved significantly poorer than the Chaika's since the heavier Condor reached speeds in the order of Mach 1.1 and in-flight control proved more difficult. These problems were eventually overcome and satisfactory results obtained through he range of speeds. In August 1955 experimental Condor bombs were again tested from the Tu-4 using TV guidance and with the navigator using a control joystick. Not only could this system be used in less favourable weather conditions, it also obviated the need for the bomber to fly over the target. Tests using an adapted Tu-16 (as 'order 251' began in March 1956, but although successful the system was not accepted for operational service. The large bomb carried externally increased drag to the detriment of both speed and range. Work on guided bombs carried externally was therefore terminated.

Tu-16 with the UBV-5 Guided Bomb

Work on a more sophisticated guided bomb, the 5,150-kg UBV-5 fitted with a 4,200-kg warhead, began in the summer of 1956. The bomb was to have a high-explosive or an armour-piercing warhead with either TV guidance (like the Condor) or an autonomous heat-seeking system (like the Chaika-2). Two variants were designed: one to be carried internally and the other semi-recessed (the latter was rejected by the Soviet Air Force). The drawback to all the Soviet guided bombs was that the carrier aircraft was obliged to release the bomb only a few kilometres from the target, increasing the risk of enemy interdiction. This problem could be overcome by the use of solid-fuel rocket motors on the bombs, so that they resembled ASMs, but the advantages of guided bombs in their simplicity and low production costs as compared with ASMs began to wane. The emphasis shifted to air-launched cruise missiles able to strike enemy warships while the launch aircraft was still some distance away. This brought an end to work on the 7,500-kg UPB rocket-powered guided bomb which was to be released at a range of 300-350km from its target.

Tu-16 with the SNAB-3000 Krab Homing Bomb

On 14th April 1957 the Council of Ministers passed directive No 1175-440 giving guidelines for guided weapons development until the mid-1950s. Among other things, the All-Union State Research Institute No 642 (GSNII-642) was tasked with developing a 3,000-kg homing bomb designated SNAB-3000 (*s**a**mon-avo**dya**shchayasya **a**via**bom**ba* – homing bomb) which was also known under the code-name Krab (Crab).

Development of the SNAB-3000 proceeded under the leadership of D V Svecharnik. The design was strongly influenced by the German Fritz X, featuring the same four large fins in a squashed-X arrangement and cruciform tailfins within a rhomboid-shaped rudder arrangement. Unlike the German prototype, however, the SNAB-3000 had swept wings. The bomb featured an AP-55 autopilot for initial guidance and an infra-red seeker head for terminal guidance. The IR seeker was activated by a timer, allowing the bomb to zero in on large targets with a high heat signature, such as factories. The warhead weighed 1,285kg.

Trials began in 1951, initially using Tu-4 carrier aircraft and 'dumb' versions of the bomb without the homing system. The fully equipped 'smart' version entered test at the GK NII VVS facility in Akhtoobinsk in late 1952. The bomb showed promising results at first, accurately homing in on pans with burning kerosene used as simulated targets; out of the 12 inert and live bombs dropped in 1953-54, eight fell within 47m of the target.

However, the piston-engined Tu-4 was slow and hopelessly outdated, so the decision was taken to use the state-of-the-art Tu-16 as the delivery vehicle. Hence a Kazan'-built Tu-16 serialled '36 Black' (c/n 4200303) was fitted with special pylons under the wings for carrying two SNAB-3000 bombs. It was then that problems began; the jet-powered Tu-16 turned out to be too fast for the bomb which became unstable when dropped at high speeds, the accuracy dropping dramatically. The strong drag generated by the bombs reduced the aircraft's range to 3,620km with two SNAB-3000s and 4,500km with one bomb versus 5,430km with a 9,000-kg free-fall bomb carried internally. To top it all, the reliability of the guidance system was all too low; of the 32 test missions flown by Tu-16 '36 Black', 16 ended in failure due to various malfunctions of the bombs. Hence on 26th August 1956 the Council of Ministers' Scientific & Technical Board convened to assess the results of the trials, cancelling all further work on the SNAB-3000.

Tu-16V High-Altitude Bomber

Work on the Tu-16V high-altitude bomber project (V = *vy**sot**nyy* – high-altitude) with two VD-7 engines was carried out by OKB-156 in the late 1950s. The VD-7 engine rated at 11,000kg thrust for take-off and 8,600kg thrust at nominal power was more fuel-efficient, lighter and smaller than the RD-3M and it was estimated that the bomber's range could be increased by about 15% with the same fuel load. The project drawings show revised engine fairings to accommodate extra batteries, as the VD-7 used electrical starting. Project work took place at the same time as V M Myasishchev's OKB-23 was working on the 3M four-engined bomber powered by the same engines, but was terminated with the cutbacks in the bomber development programmes at the end of the 1960s. Another factor was that the service introduction of the 3M revealed serious problems with the VD-7 which were not resolved until series production of the Tu-16 was drawing to a close.

Tu-16 with Unguided Rocket Defensive Armament ('order 227')

Trials of this tail defence system using TRS unguided rockets housed in a launcher that could be elevated vertically through 30° were scheduled for the autumn of 1956. The system was developed in accordance with Council of Ministers order No 2253-1069 of 3rd November 1954 and MAP order No 693 of 13th November. A production Tu-16 was made available for trials but development was apparently then terminated.

Tu-16T Torpedo-Bomber ('order 210', *izdeliye* NT)

The use of the Tu-16 as a torpedo-bomber by the Naval Air Arm (AVMF) was an inherent factor in the aircraft's design, and all Tu-16 bombers were to be capable of carrying mines or torpedoes. CofM instruction No 7501 to this effect was issued on 12th July 1954, followed by MAP order No 432 on 15th July. The relevant manufacturer's tests and state trials were made in 1954 on Kazan'-built Tu-16 c/n 4200501 which thus became the torpedo-bomber prototype produced as 'order 210' and designated Tu-16T or *izdeliye* NT in naval service. The aircraft was ordered into production by CofM directive No 163-97 of 2nd February 1955 and MAP order No 127 of 1st March.

Possible weapons loads to be carried consisted of four RAT-52 torpedoes, or six 45-52 VT torpedoes, or eight AMD-500M (or APM), IGDM or AGDM-2M Lira (Lyre, pronounced ***lee**ra*) mines.

Production of the Tu-16T (based on the prototype) began at plant No 64 in 1955, with orders for 25 new-build examples in that year and for the conversion of 20 bombers. Production continued until 1957, by which time 76 examples of the Tu-16T had been built at Voronezh, apart from the conversion of Tu-16 bombers operated by the AVMF. The Tu-16T was refitted to carry mines and torpedoes with a revised electric weapons release system and additional control panels in the navigator's station. Special securing chains were also fitted to prevent the torpedo being inadvertently released.

Production examples of the Tu-16T had revised weapons bays to carry two RAT-52 rocket-powered torpedoes, six high-altitude 45-54VT or low-altitude 45-56NT torpedoes, two BV-20 depth charges, 12 AMD-4-500 bottom mines or four AMD-4-1000 mines. Rocket-propelled RM-1 and RM-2 surface mines, UDM universal bottom mines, MDM-3, MDM-4 and MDM-5 bottom mines, the Serpei and Lira anchored mines, AMD-2M, IGD-M and Desna mines, UPAMB-100/80 practice mines and 45-36MAV torpedoes could also be carried. The overall weapons load was 8.7 tons. The Tu-16T could also carry a full 9,000kg bomb load. Some aircraft were equipped with ECM gear, including the Buket jammer. Externally the Tu-16T differed little from the bomber version except in the weapons bay doors.

Intended for low- and high-altitude torpedo attack and mine-laying, the Tu-16T had a top speed of 992km/h at 6,250m with an all-up weight of 55,000kg. With the same flying weight, the top speed was 938km/h at 10,000m. Its range at optimum altitude with a take-off weight of 72,000kg and a 3,000kg load of torpedoes or mines was 5,760km. Its service ceiling with the engines at nominal power was 12,800m, an altitude the Tu-16T reached in 31 minutes. Its take-off run with a 71,560-kg AUW was 1,900m, and the landing run with a 44,000-kg landing weight was 1,655m. Like the bomber version of the Tu-16, the Tu-16T was known to NATO as the *Badger-A*. By the early 1960s the more formidable anti-aircraft defences employed by naval vessels made the use of torpedo-bombers impractical, and the Tu-16T fleet was converted into Tu-16PLO ASW aircraft or Tu-16S SAR aircraft. Six examples of the Tu-16T were supplied to Egypt.

Tu-16 Mine-Layer

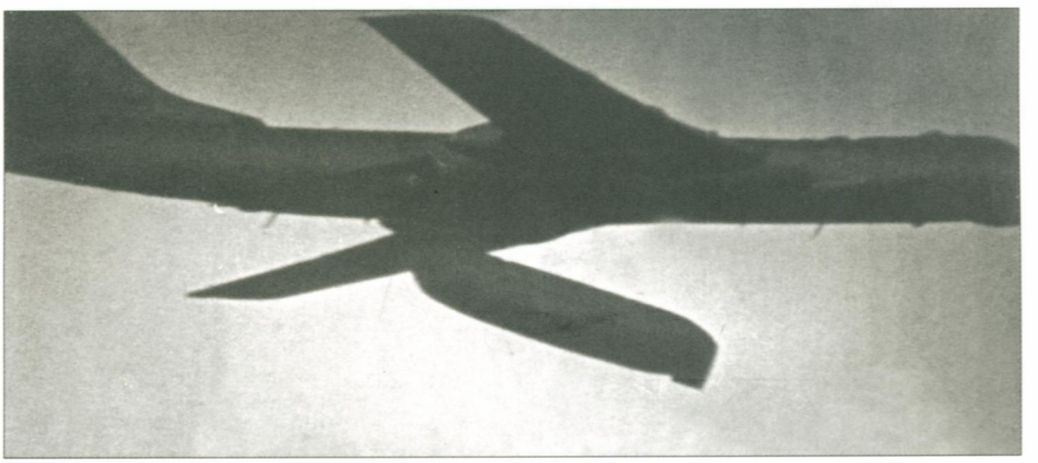
Some versions of the Tu-16, particularly the Tu-16P (SPS), the Tu-16 Yolka and the Tu-16R (these versions are described later) in AVMF service were refitted as mine-layers in accordance with 'order 699' with the option of reverting to the bomber version if required. Some Tu-16s in service with the Red Banner Baltic Fleet Air Arm were thus modified in the early 1970s. Superfluous equipment was removed and cassette-type racks for mines fitted in the weapons bay.

Tu-16PLO (Tu-16PL) Anti-Submarine Warfare Aircraft

Starting in 1962, a number of Tu-16T torpedo-bombers were converted for anti-submarine warfare (ASW) as the Tu-16PLO (or Tu-16PL). These were intended for ASW operations using the Baku sonobuoy system within a range of 1,000km (without in-flight refuelling) from their bases. The system comprised the SPARU-55 airborne automatic detection set (*samo**lyot**noye pree**yom**noye avtoma**tich**eskoye **rah**diou**stroy**stvo*), sonobuoys (each one transmitting on its own frequency), an ANP-18 automatic navigation instrument, a RPB-4 radar bombsight and a PP-1 panoramic receiver/display. The sonobuoys were dropped in a pattern around the submarine's presumed location, picked up its sound and relayed information on its position and characteristics to the aircraft. A decision as to an attack method could then be taken, or the information received relayed t o other aircraft. The search version carried either 36 RGB-NM or 24 RGB-N buoys, the search/attack version either 18 buoys and two AT-1 torpedoes or 12 buoys and one nuclear depth charge, and the attack version was armed with either two AT-1 torpedoes, 25 PLAB-50 depth charges or six RM-1 rocket-

This still from the late 1980s Soviet motion picture *The Incident in Grid Square 36-80* shows the Tu-16S SAR aircraft taking off with the Fregat lifeboat suspended under the fuselage. Tupolev JSC

Another still from the same movie showing the lifeboat falling away from the Tu-16S as the Soviet Navy tries to extend aid to a US Navy submarine in distress. Shortly after the lifeboat splashed down the submarine's computer went terminally haywire, executing an uncommanded missile launch against a group of Soviet warships, whereupon the sub was scuttled by her crew. Tupolev JSC



propelled mines. The AT-1 torpedoes had acoustic homing and were dropped by parachute from an altitude of 2,000m. On striking the water, the torpedo travelled in 60-70m circles until the submarine was detected – making its final attack run at a speed of 48-52km/h. The Tu-16PLO had a take-off weight of 79,000kg, carrying a 3,000-kg weapon and equipment load and patrolled at a speed of 420-430km/h Its range was 5,400km and its service ceiling 13,000m.

Conversion of the Tu-16T into the Tu-16PLO as per 'order 64' was carried out from 1962 onwards in the North Fleet and from 1963 onwards in the Pacific Fleet.

Tu-16S Maritime Search and Rescue Version ('order 454', izdeliye NS)

Work on a search and rescue version for the Soviet Navy designated Tu-16S (*spa**sah**tel'nyy* – rescue, used attributively) began in 1955 pursuant to Council of Ministers directive No 1952-1047 of 26th December. The aircraft carried a *Fre**gaht*** (Frigate) radio-controlled powered lifeboat designed by I F Nezval' at the Tomilino branch of OKB-156. After locating the area where a vessel or aircraft was in distress by means of its onboard radar and spotting survivors (or cosmonauts, in the event the re-entry module splashed down instead of landing in the steppes of Kazakhstan, as was customary) the Tu-16S paradropped its lifeboat and started the latter's engine by radio. The boat was steered towards the rescue area by TV control. The system was successfully tested by the Baltic Fleet and passed for service with the Soviet Naval Air Arm. In 1965 the Tu-16 production factories began conversion of some of the Tu-16 torpedo-bombers remaining in service as 'order 454'. Most saw service with the Northern Fleet until the late 1980s. Regrettably, the last examples were withdrawn just before the loss of the Soviet nuclear-powered submarine SNS *Komsomolets* (K-278); had they been active, the number of survivors might well have been much higher.

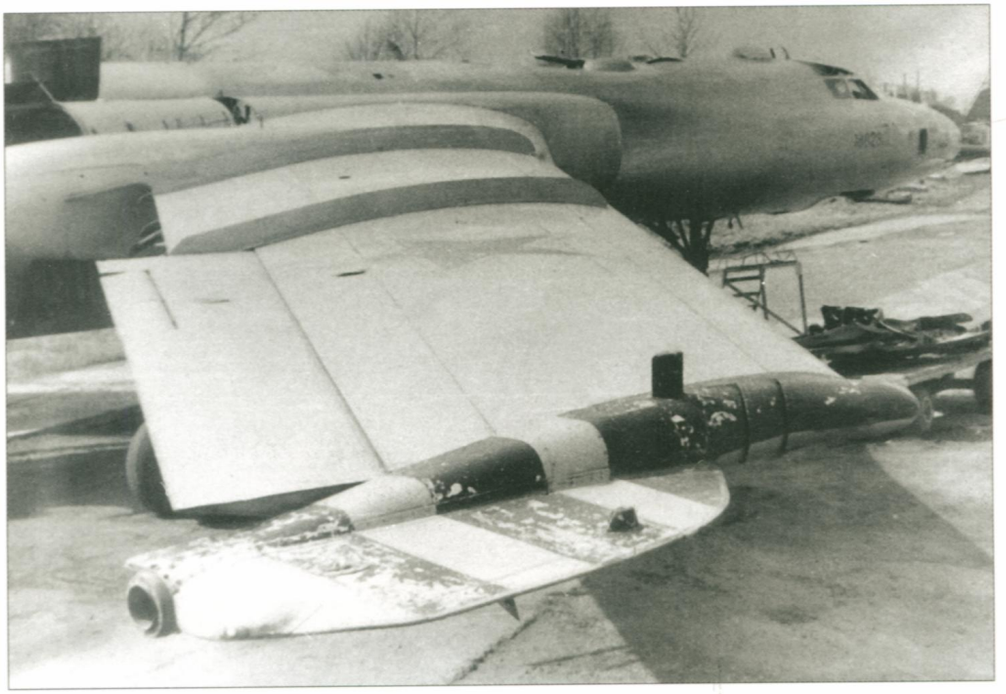
Tu-16SP ASW Search Version

The Tu-16SP carried a powerful search radar (similar to that used on the Tu-142 ASW aircraft) in its weapons bay able to detect submarines either on the surface or at periscope depth. ASW torpedoes or sonobuoys could also be carried. A number of these conversions was carried out in the 1970s. Compared to the Tu-142, the Tu-16SP had far shorter range and endurance; the service introduction of the dedicated long-range Tu-142 meant that the Tu-16SP was phased out.

Tu-16G (Tu-104G) Special Delivery Aircraft

Before the Tu-104 entered service, three production Tu-16 bombers were transferred to Aeroflot and used to deliver the matrices of national newspapers to regional capitals where the papers would be printed. (If the papers were delivered to the eastern regions of the Soviet Union all the way from Moscow, they

СССР-Л5411 (that is, SSSR-L5411, c/n 1881301), one of several Tu-16s temporarily demilitarised for carrying newspaper matrices and for crew training duties during the Tu-104 airliner's service introduction period. Visible beyond is Tu-16A '72 Red' (c/n 4200401). Yefim Gordon archive



Close-up of the starboard wingtip of a decommissioned Tu-16(Z) tanker ('30 Black', c/n 1882801), showing the conduit through which the fuel transfer hose exits and the horizontal 'winglet' whose purpose is to minimise the destabilizing effect of the wingtip vortex on the hose; red and white stripes are applied to this 'winglet' to make it more conspicuous. The slits immediately ahead are the de-icing system hot air outlet. Yefim Gordon archive

Tu-16(Z) '26 Red' (c/n 1882108) comes in to land, showing the hose conduit protruding aft from the starboard wingtip. Yefim Gordon archive

Another Tu-16(Z) passing overhead shows that it has the famous 'winglets' on both wings, suggesting that it has a refuelling receptacle as well. Yefim Gordon archive

would be one day old by the time they were on the street, and who wants yesterday's news?) All armament was removed and the weapons bay used for containers. Designated Tu-16G or, rather misleadingly, Tu-104G (*groozo**voy*** – cargo, used attributively), the aircraft saw limited service with Aeroflot before its function was taken over by new methods of data transmission. A small number of Il'yushin IL-28 bombers was similarly used under the designation IL-20, starting in 1954.

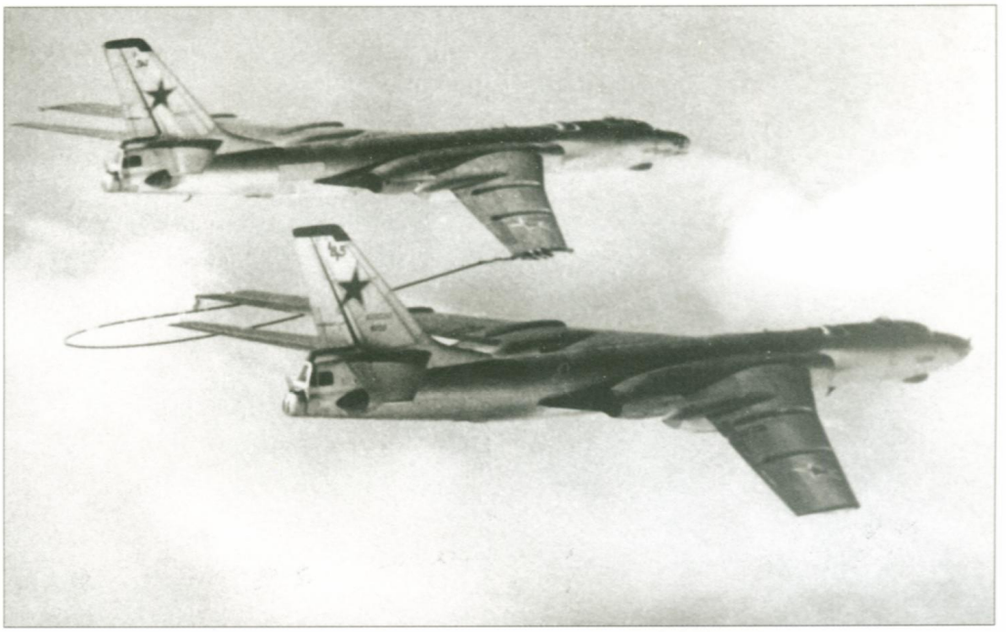
Tu-104G Civil Aircrew Conversion Trainer

A small number of IL-28 and Tu-16 bombers with all armament and military equipment removed were transferred to Aeroflot to facilitate aircrew conversion training in anticipation of the Tu-104 jet airliner's service introduction. Again designated Tu-104G, the demilitarised Tu-16s received civil registrations, carrying Aeroflot titles and winged logo on the forward fuselage sides. Only one aircraft registered CCCP-Л5415 (that is, SSSR-L5415; c/n 1881301) has been positively identified; however, c/ns 1881302 through 1881304 have also been reported as Tu-104Gs. When sufficient numbers of the 'true' Tu-104 became available, allowing the airliners to be used for crew training between scheduled flights, the Tu-104Gs were returned to the Soviet Air Force and 'remilitarised'.

Tu-16 In-flight Refuelling Tanker – Tu-16Z, Tu-16Yu ('order 198', *izdeliye* NZ)

Ways of extending the Tu-16's range were explored even during the project stage. One of these was the wingtip-to-wingtip in-flight refuelling method developed at LII by Igor' Shelest and Viktor Vasyanin in 1948; first used operationally on the Tu-4 in the early 1950s, it was practiced on a very limited scale by the Soviet Air Force. In all, no more than ten machines were involved either as tankers or receivers. However, the experience gained with the Tu-4 convinced OKB-156 that the technique was applicable for jet bombers as well. On 17th September 1953 MAP issued order No 44 giving specific instructions for the development of the IFR system; in particular, all new bombers

A Tu-16(Z) tanker coded '34 Red' (background) refuels a Tu-16K-11-16 'radar killer' aircraft coded '85 Blue' (c/n 6203310/3060?) flying over thick overcast. Note the stabilising drogue parachute at the end of the hose just visible beneath the receiver aircraft's wingtip. Yefim Gordon archive



A classic action shot showing another Tu-16K-11-16, '28 Red', taking on fuel from a Tu-16(Z). Note the reference marks on the hose. Apart from the unusual white-painted fin tip fairing, the receiver aircraft is interesting in that it was converted from a very early Kuibyshev-built aircraft with one-piece mainwheel well door forward segments. Unusually, the tail bumper has not retracted after gear retraction. The white rectangle on the tanker's rear fuselage is a formation keeping reference point for the receiver aircraft's pilots. Yefim Gordon archive

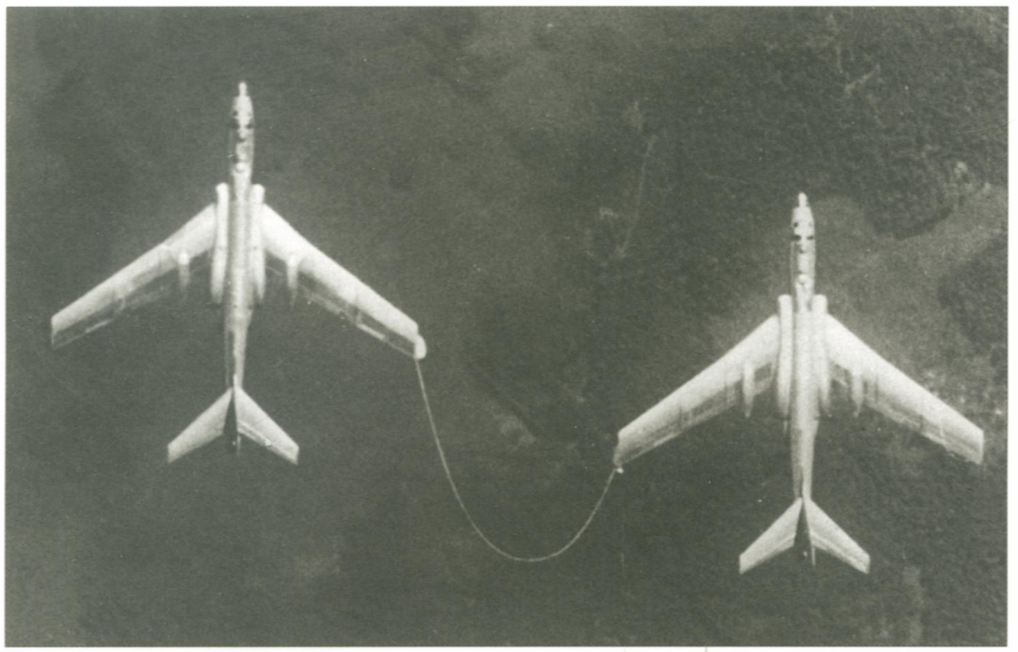
In-flight refuelling was vital during overwater operations in which the Tu-16 was actively involved. The tanker is a Batch 29 Kuibyshev-built aircraft. Yefim Gordon archive

developed henceforth were to have provisions for in-flight refuelling.

Given the co-operation of OKB-918 under Chief Designer Semyon M Alekseyev which assisted in bringing the system up to scratch, the test pilots involved in the Tu-4's IFR tests, LII, and the Soviet Air Force, two Tu-16 bombers adapted at the Kazan' factory as the tanker and the receiver aircraft could be ready for State acceptance trials by January 1955. Council of Ministers issued directive No 1013-438 to this effect on 26th May 1954, giving more accurate specifications for the system, followed by MAP order No 354 of 3rd June.

The tanker prototypes were, in fact, not Kazan'-built aircraft but the first production examples from Kuibyshev (c/ns 1880001 and 1880101). Later, Tu-16 c/n 1880301 was also modified as a tanker to investigate IFR techniques for the Mikoyan/Gurevich MiG-19 tactical fighter.

The first Tu-16 (Z) (the Z stood for for *za**prahv**shchik* – tanker) began an almost 18-month test programme in 1955. Taking due note of the criticisms made, OKB-156 made the necessary corrections and revisions and prepared the technical documentation for the production factories. Thirty Tu-16 were then modified in accordance with CofM directive No 247-159 of 15th February 1956 and MAP order No 111 of 23rd February, ten as tankers and 20 as receivers, for Air Force trials which were held successfully in late 1956. From early 1957 all three production factories were required to incorporate IFR capability on the Tu-16 while carrying out modification and refit work. Tanker versions in production were referred to as 'order 198', and in service as the Tu-16 (Z) (later simply Tu-16Z), Tu-16Yu or *izdeliye* NZ. Receiver aircraft had the ZA suffix at first (standing for for *zapravl**ya**yemyy samol**yot***), but this lapsed with time, as almost all examples remaining in service were IFR-capable. During production the receiver aircraft was referred to as 'order 229'.



Another refuelling scene. This view illustrates the shape which the refuelling hose assumes after the receiver aircraft makes contact and moves into position. Yefim Gordon archive

'02 Red' (c/n 7203428), a Tu-16N hose-and-drogue tanker. Note that the aircraft wears the 'nuclear'; white colour scheme usually worn by Tu-16As (no doubt having been converted from one of those) and has been retrofitted with a jammer covering the forward hemisphere for self-protection, as revealed by the ECM antenna 'horn' above the flightdeck. Yefim Gordon archive

During the IFR operation the receiver aircraft assumed echelon starboard formation with the tanker, which then deployed a hose attached to a cable from its starboard wing. The receiver aircraft placed its port wing on the hose and manoeuvred so that the hose slid along the wing until it was stopped by a fitting under the wingtip. The hose was then rewound by the cable until its end was automatically connected to the receiver aircraft's refuelling receptacle. When this had been done, the two aircraft took up close formation with the tanker slightly ahead. Decoupling of the two aircraft could be effected at any stage in the process, either by the operator or automatically if the two aircraft drew apart. Supervision and control of the fuel transfer was the responsibility of the co-pilot in each aircraft while the aircraft's captain manoeuvred and then maintained formation.

In its final form, the tanker had a normal take-off weight of 75,800kg and carried a maximum 24,500kg of transferable fuel. IFR was practiced intensively over the sea during training, reconnaissance and patrol flights both by the DA and the AVMF. One refuelling increased the Tu-16's range by almost 2,000km, and a second refuelling raised this to almost 3,500km (with 5% fuel reserves).

The wingtip-to-wingtip refuelling method had its advantages in that the aircraft being refuelled was not in the tanker's wake vortex, a tight formation between the two aircraft was not essential, and the components of the system were straightforward and uncomplicated. There was, however, the risk of damage to the wing skin if the initial contact was made clumsily, and no option for a second coupling if the drogue parachute stabilising the hose was lost.

An added bonus was that the Tu-16 was able to operate from shorter and less heavily concreted runways by taking off with a substantially lower fuel load (that is, a take-off weight of 60,000kg) and then taking on fuel in the air immediately afterwards. The range in this case could be slightly greater than if the aircraft had taken off with a full fuel load. Experience also proved that it was easier to carry out IFR at altitudes lower than the cruise altitude, since the engines had a bigger power reserve and piloting was easier.

In the autumn of 1955 IFR experiments were made in accordance with the aforementioned Council of Ministers directive No 1013-438 and MAP order No 354, involving two specially modified MiG-19s (manufacturer's designation izdeliye SM-10) using the wingtip-to-wingtip method. The fighters serialled '316 Red' (c/n 59210316) and '415 Red' (c/n 59210415) were modified by OKB-155 (the Mikoyan design bureau) and the Tu-16 tanker (c/n 1880301) by OKB-156 and OKB-918, although the tanker's refuelling equipment remained virtually unchanged, apart from the replacement of the normal 88mm hose by one 50mm in diameter. A Komissarov was the chief engineer for the project, with Igor' Shelest as LII's project test pilot. Some 3,000 litres of fuel could be transferred at a rate of 1,000 litres per minute – half the usual transfer rate for Tu-16 to Tu-16 refuelling. During one test the MiG-19 was twice refuelled in the air and able to remain airborne for six hours. Refuelling could be carried out several times during a mission – both in the daytime, unless impeded by cloud, or by night using fixed and manually trained lights.

The vortex generated by the Tu-16 wingtip caused problems, but after initial factory tests

in 1956 the SM-10 and its Tu-16 tanker were handed over to LII for further testing with a revised hose. This had a more reliable attachment mechanism, was less prone to folding, was less affected by the tanker's wingtip vortex and was shorter. Factory tests of the new fuel hose proved favourable, but the verdict of the ensuing State trials was that the method was too difficult. Work on IFR for fighters was therefore shelved, resuming only in the 1970s.

According to OKB-156, 114 Tu-16 bombers were converted to serve as wingtip-to-wingtip tankers (other sources give a total of 46), and 571 aircraft – over a third of all the Tu-16 built – were equipped as receivers. Tanker aircraft could be reconfigured as bombers by field maintenance units by removing the extra fuel tanks from the aircraft's weapons bay, although later the OPB-11R sight was also removed, making reversion impossible. The performance of receiver aircraft was not affected by the addition of the IFR receptacle to its wing.

Tu-16N In-Flight Refuelling Tanker ('order 358', *izdeliye* NN)

With the introduction of the supersonic Tu-22RD, Tu-22KD, Tu-22PD and Tu-22UD bombers equipped with refuelling probes (D = ***dahl'niy*** – long-range) into Long-Range Aviation and Naval Air Arm service in the 1960s, the conversion of the Tu-16 into a probe-and-drogue IFR tanker was again considered. In-flight refuelling of the Tu-22 had been carried out using Myasishchev 3MS-2 tankers, but after several years of practice by the Soviet Air Force the drawbacks of this combination became apparent, as did the advantages of using a lighter tanker able to use the same or similar airfields as the Tu-22. Being based solely at Engels-2 AB in southern central Russia, the 3MS-2s had to fly across almost the whole extent of European Russia to reach the rendezvous zone, whereas the Tu-16 tanker could operate from neighbouring airfields in the Ukraine or Belorussia.

The refuelling system in use on the 3MS-2 was adapted and developed on suitably modified Tu-16 c/n 1882401. From 1963 several Tu-16 were converted as 'order 358' at Kazan and designated the Tu-16N or *izdeliye* NN in service. The tanker could revert to bomber configuration if necessary. In 1966 a Tu-16N (c/n 1882314) underwent refuelling trials with a Tu-22RD (c/n 3083012) reconnaissance aircraft as the receiver aircraft. The success of these prompted the conversion of 23 Tu-16 bombers to Tu-16N standard at the Kazan' factory between 1968 and 1970. With a single top-up from the Tu-16N the Tu-22 had an increased range of 7,200km, increasing to 8,000km with two top-ups. Using IFR once on the outbound leg and again on the return flight further extended the range to 8,500km. The Tu-16N itself had a normal take-off weight of 76,670kg, but could carry a maximum transferable fuel load of 19,500 litres. Refuelling took place at a speed of 630km/h and at an altitude of 6,000m. With improved drogue-and-hose equipment the Tu-16N served on into the 1980s. The Tu-16N was yet again referred to by NATO as the *Badger-A*.

Experimental Tu-16 (Tu-16D?) Probe-and-Drogue Refuelling Receiver

In the late 1950s a single Tu-16 was converted into a receiver aircraft using the probe-and-drogue IFR technique. Although the trials were successful the method was not adopted. This modified Tu-16 was used, however, in developing IFR equipment for the Tu-95KD and Tu-22KD long-range ASM carriers. The designation Tu-16D has been reported for this version, although it was not officially used during the trials.

Tu-16NN Tanker

Several standard Tu-16(Z) tankers were converted to probe-and-drogue tankers in 1969 along the lines of the bombers converted to Tu-16N standard. Although designated Tu-16NN, they were so similar to the Tu-16N that they were referred to as the Tu-16N in Soviet Air Force service. In all, some 20 Tu-16(Z)s were converted into Tu-16NN tankers.

The broadly similar Tu-16NN was the last of the tanker variants, and these aircraft were converted from whatever was available – except missile strike versions. This example (c/n 1882302) coded '41 Red' on the nose gear doors and '41 Blue' on the tail (!) used to be a Tu-16R coded '35 Blue'. Yefim Gordon archive

'45 Blue' (c/n 1882503), another Tu-16NN. Yefim Gordon archive

The Missile Carriers

Tu-16KS
('order 187', *izdeliye* NKS)

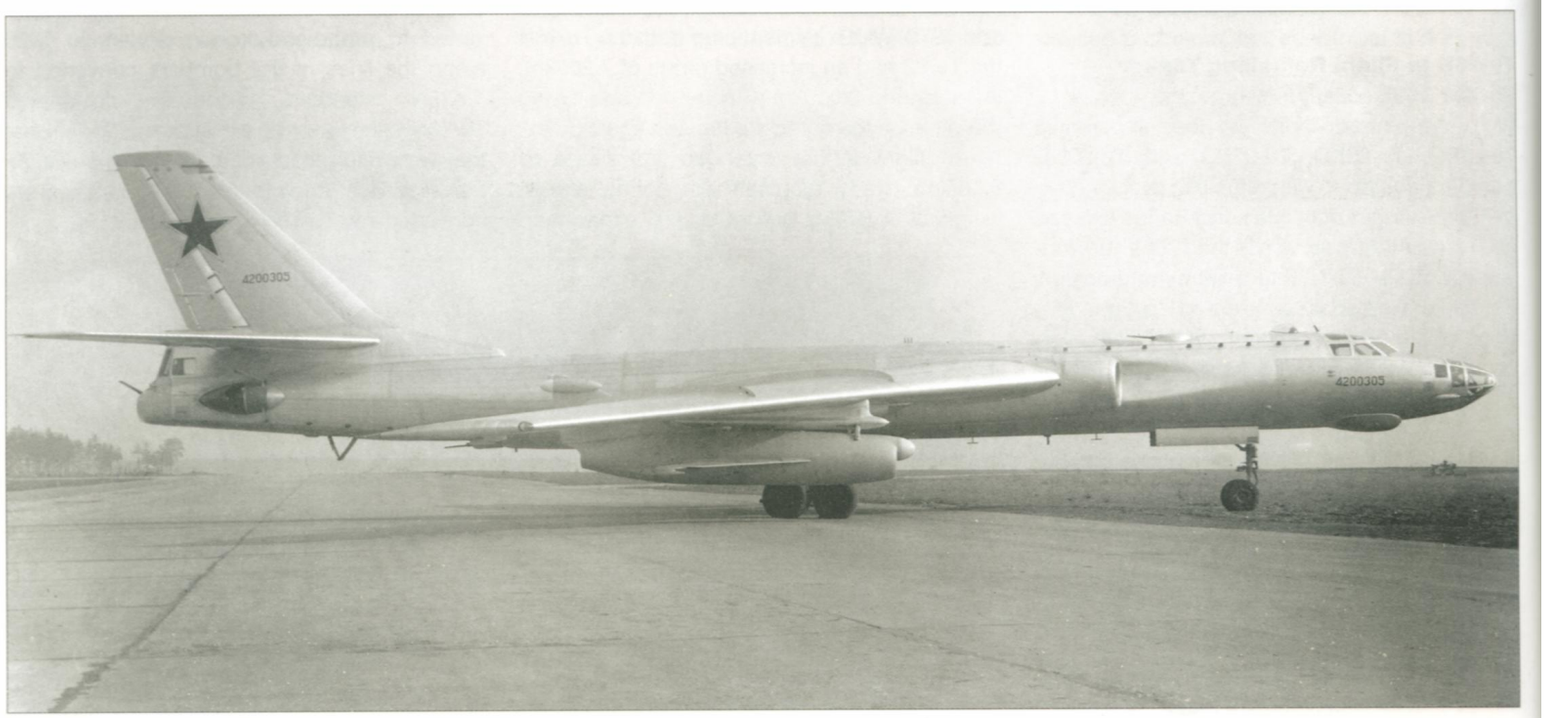
Work on the first Soviet long-range air-to-surface missile system began in 1947, involving development of the missile by a section of Mikoyan's OKB-155 (Mikhail I Gurevich was project chief, with Aleksandr Ya Bereznyak in charge of the actual design). The carrier aircraft was developed by Tupolev's OKB-156 (under A V Nadashkevich) and the missile's control and guidance system by SKB-1 (under Sergey L Beria, son of the infamous KGB chief Lavrentiy P Beria); the latter design bureau bore overall responsibility for the system as a whole.

The missile was developed in three versions: as an air-to-surface missile (the KS-1), as a ship-to-ship missile (the KSS) and as a surface-to surface missile (the KS-7). All three missiles were very similar and varied only in their provision for their specific function.

In June 1948 the Soviet Council of Ministers issued a directive on the creation of the *Kometa* (Comet) weapons system, which involved adapting Tu-4 bombers to enable them to launch air-to-surface missiles against surface vessels over an operational range of up to 2,000km from their bases. The missile to be used was the KS-1 'winged missile' (*izdeliye* E) which resembled a scaled-down MiG-15 fighter (KS stood for *kry**lah**tyy sna**ryad*** – winged missile). In 1950 the ASM was ready for testing as the diminutive *izdeliye* K proof-of-concept aircraft (a manned version of the actual KS-1 with a bicycle landing gear and a cockpit instead of the explosive charge), and in 1952 the first true missiles were tested and placed in series production. The production KS-1 was 8.29m long. It featured wings swept back 55°, with a span of 4.772m. The missile was powered by a RD-500K turbojet engine with fuel load of 330 litres and carried a 1,000-kg warhead over a range of 70-90km at a maximum speed of 1,050-1,100km/h.

The guidance system devised by SKB-1 for the KS-1 consisted of a K-2 radio control unit with a receiver antenna on the fin, plus a K-1 passive radar homing set for terminal guidance installed in the nose, both linked to an APK-5 autopilot. The carrier aircraft's K-3 target illumi-

The unserialled Tu-16KS prototype (c/n 4200305) with two KS-1 air-to-surface missiles seen during trials. Note the one-piece forward-hinged main gear door segments and the hemispherical bottom of the Kobal't-1N radar's radome which was taken straight from the Tu-4KS. Tupolev JSC



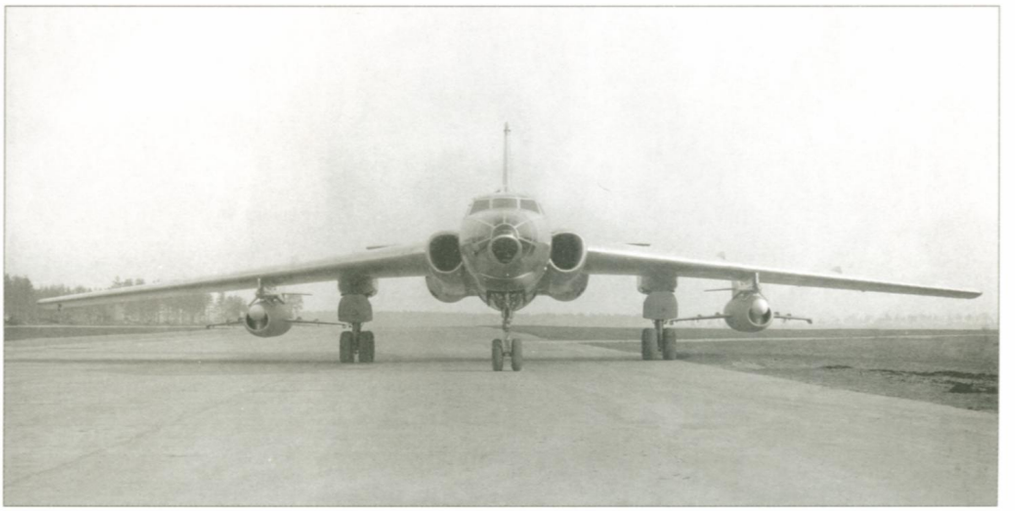
Another view of the Tu-16KS prototype. The KS-1 was quite a large weapon. Note how the command link antenna at the top of the fin is positioned above the wing upper surface when the missile is on the wing. Tupolev JSC

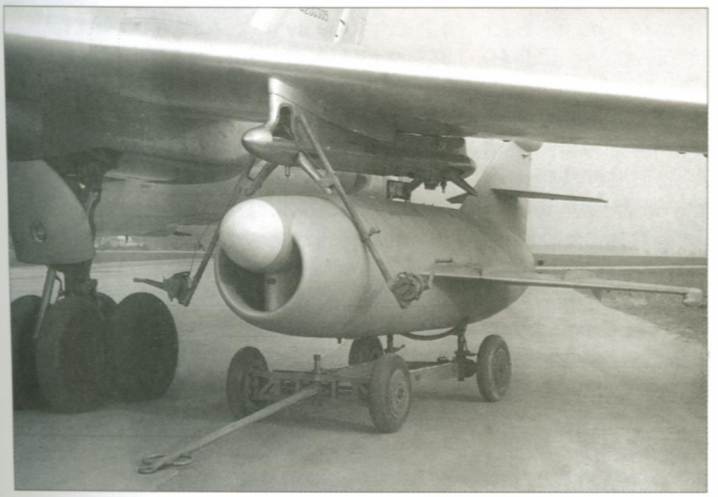
nation and missile guidance system comprised a *Kobal't* (Cobalt) 360° search radar which provided search, detection, lock-on and target tracking. Once the target had been detected, it was tracked by the Kobal't radar; the missile was then launched and radio-controlled directed by the weapons systems operator (WSO) until the missile's own homing radar (receiving reflected echoes from the target which was continuously illuminated by the Kobal't radar) could take over.

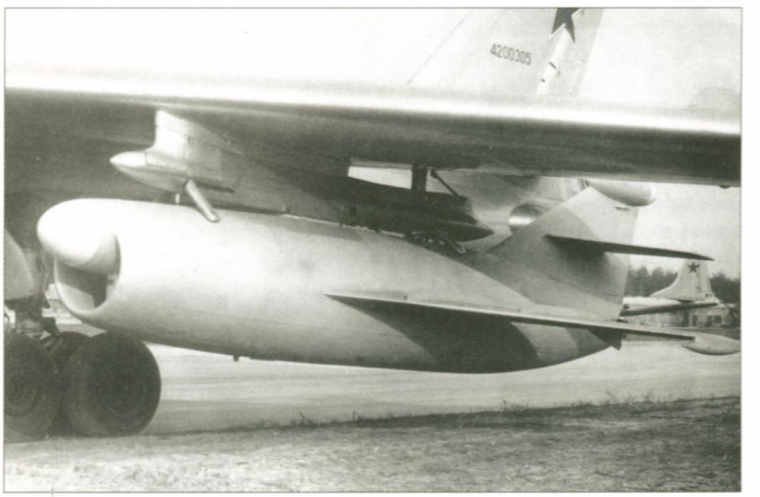
The Tu-4KS (alias Tu-4K) made the first successful practice launch on 21st November 1952, destroying a decommissioned ship used as a target; the Kometa system became operational in September 1953. The KS-1 missiles were manufactured at Dubna and some 50 Tu-4 bombers were modified as Tu-4KS missile strike aircraft at plant No 23 in Fili, then a western suburb of Moscow (now a part of the city). They remained the sole Soviet ASM carriers for several years.

The availability of the Tu-16 immediately offered a better air-to surface missile carrier able to reach high subsonic speeds, an altitude of 12,000-13,000m and possessing a large combat radius. The bomber was immediately adapted to take the Kometa system; the resulting aircraft received the designation Tu-16KS (it was also known in service as *izdeliye* NKS and at the production plants as 'order 187').

A Kazan'-built Tu-16 with no tactical code (c/n 4200305) was the first to be modified to







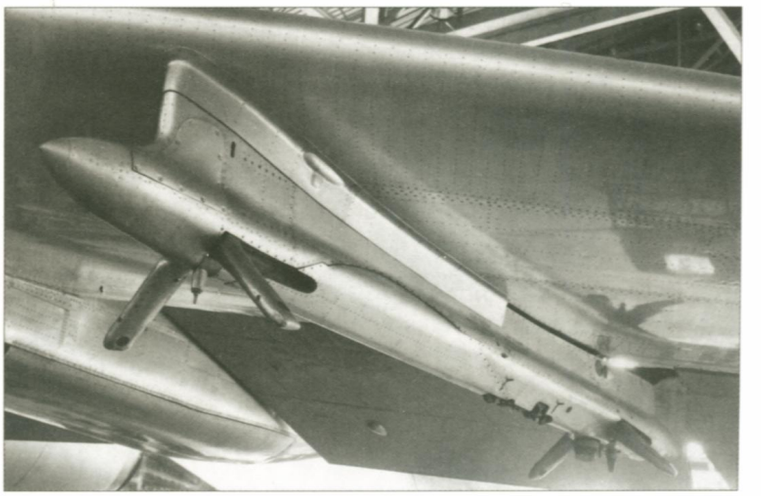
Top right: **Front view of the Tu-16KS prototype, showing how the pylons' retaining arms fit around the fuselages of the saucily grinning missiles.**

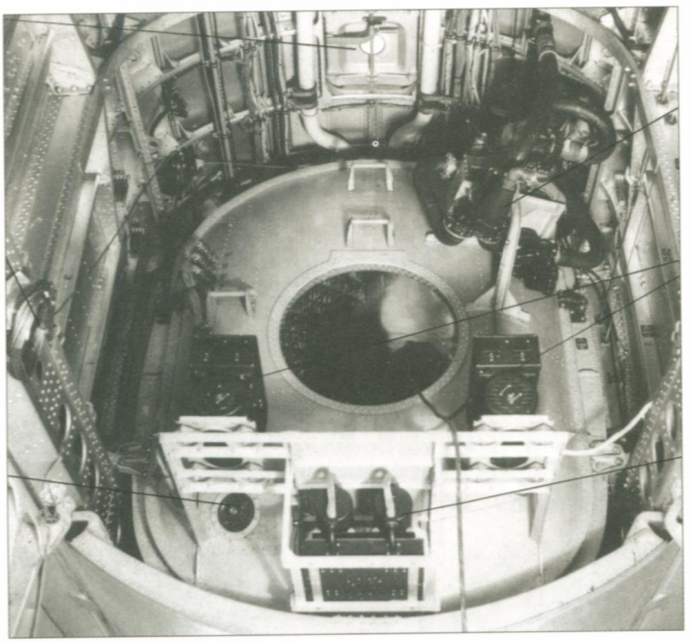
Upper right: **The same aircraft with two torpedoes on the missile pylons; apparently it was used for development work which led to the appearance of the Tu-16T torpedo-bomber. The torpedoes appear to be dummies.**

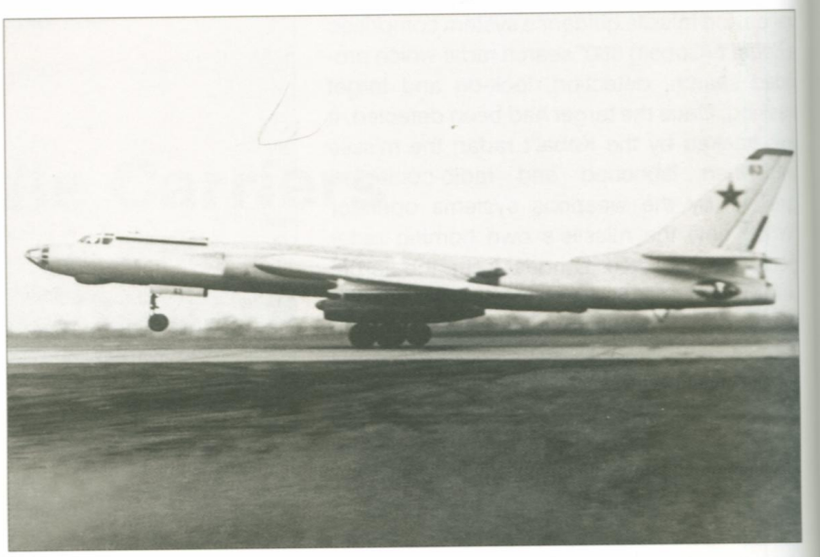
Above left: **This view shows to good effect how the KS-1 missiles were lifted into position from their ground handling dollies, using hand-driven hoists. Note the windows for the landing lights in the main gear doors.**

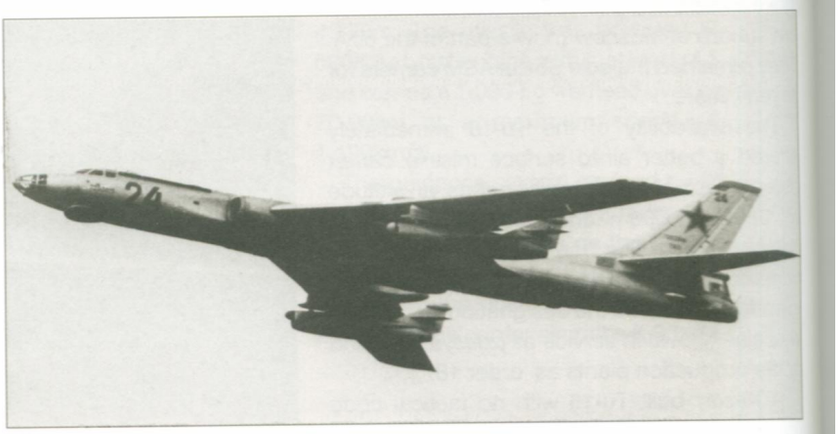
Above right: **Close-up of a KS-1 in position on the prototype's port pylon. The weight of two missiles and the resulting compression of the main gear oleos caused the Tu-16KS to assume a nose-up attitude on the ground.**

Right: **The port BD-187 missile pylon of the Tu-16KS prototype. The retaining arms folded away to reduce drag after the missile had been launched. The suspension lock is located closer to the rear pair. Note that the pylon has a cutout closed by a metal fairing; this was a provision for carrying the manned test version of the KS-1 (the *izdeliye* K).** All Tupolev JSC









Above: **A view through the open bomb bay doors of the Tu-16KS prototype, showing the missile launch operator's self-contained pressure cabin. Note the dorsal escape hatch at the top of the picture.** Tupolev JSC

Above right: **A production Tu-16KS coded '63 Blue' takes off, carrying two KS-1s. The missiles are painted bright red overall, revealing that they are inert examples.** Yefim Gordon archive

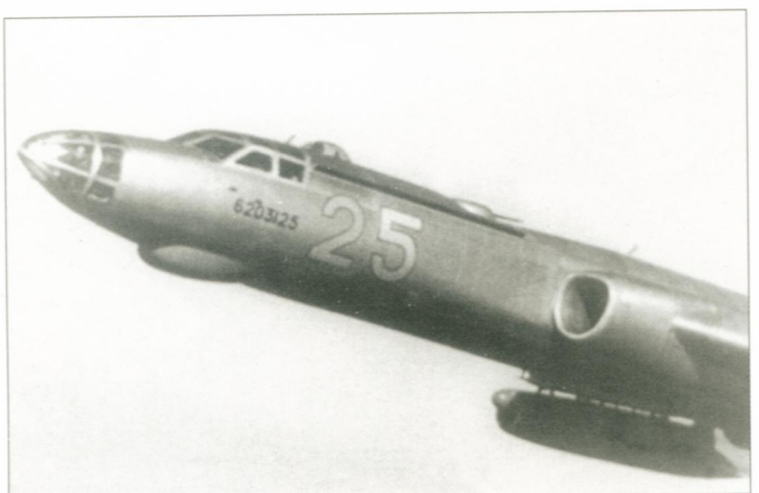
Right: **Tu-16KS '24 Red' (c/n 7203819/'7163') makes a low-level pass, carrying two KS-1s. Note that the missiles' nose radomes are of different colours.** Yefim Gordon archive

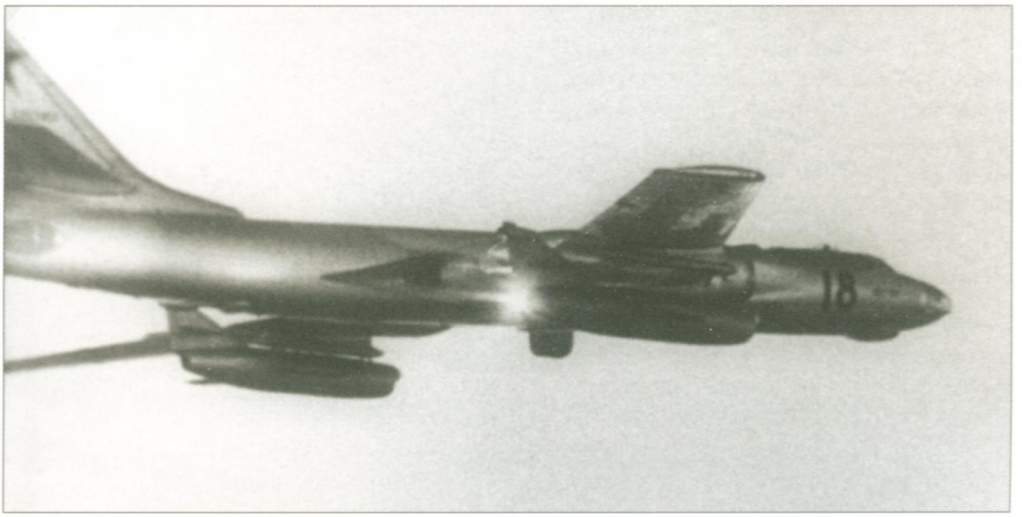
missile carrier configuration. This involved adaptation of the bomb bay to house the WSO's pressurised workstation and elements of the K-1M Kobal't-1M radar (including a revolving antenna in a semi-retractable radome), the addition of missile pylons under the wings (which had to be reinforced accordingly) and modifications to the fuel system enabling the KS-1 missiles to be fuelled from the carrier. Manufacturer's tests were held between August and November 1954 with test pilot Yuriy T Alasheyev at the controls. A total of 18 flights was made, totalling 9 hours and 14 minutes. The KS-1 was released at altitudes between 3,500 and 4,000m and indicated airspeeds up to 370km/h without any detrimental effect on the aircraft's handling; the aircraft's AUW was 58,000-59,000kg. With two missiles the Tu-16KS clocked a maximum speed of 575km/h without any vibration generated by the external stores. The take-off run with two missiles and an all-up weight of 54,000kg was 1,240m – the same as for the bomber version. In fact, handling during take-off or landing was barely affected at all, although the landing speed with a landing weight of 47,000kg (with both missiles) was 10-15km/h greater.

Tested at altitudes of 4,000m, 6,000m and 8,000m, the K-1M radar had a detection range of 160km, and lock-on and automatic target tracking were stable and consistent. When flying with a single missile under the port wing, stability could be maintained by transferring fuel to the starboard wing, and when the antenna for the K-1M was lowered it was recommended that the maximum speed should not exceed 520-550km/h to prevent vibration from the radome. After these tests Tu-16KS c/n

Below left: **Close-up of the nose of Tu-16KS '25 Blue' (c/n 6203125) seen from a sister ship – probably a tanker. Production aircraft usually had strake aerials on the forward fuselage, as distinct from the prototype which had 'towel rail' aerials.** Yefim Gordon archive

Below right: **This view of a Tu-16KS shortly before missile launch shows the angular radome (a feature of production examples) in fully deployed position, the missile launch operator's entry hatch immediately aft of it and the ventral windows flanking the said hatch.** Yefim Gordon archive





The KS-1 missile under the starboard wing of Tu-16KS '18 Red' ignites its engine prior to launch. Yefim Gordon archive

Seconds later, the missile falls away and accelerates towards its target. Yefim Gordon archive

4200305 was ferried to Bagherovo airfield in the Crimea for further tests at the special weapons training range located there.

In early 1955 the Tu-16KS prototype passed its tests at Bagherovo and was recommended for series production for the AVMF. Between 1954 and 1958 a total of 107 examples were built at plant No 22 in Kazan' in parallel with the Tu-16A bomber (59 of these built in 1958 were IFR-equipped and known as the Tu-16KS (ZA)). About 40 Tu-16KSs were supplied to Indonesia and Egypt in the early 1960s, and a further 65 subsequently upgraded to carry KSR-2 and KSR-11 air-to-surface missiles as the Tu-16KSR-2 and Tu-16K-11-16 respectively.

The Tu-16KS missile system was intended for attacking radar-defined maritime and land targets within a maximum combat radius of 1,800km with a cruising speed of 800-850km/h and an all-up weight (with both missiles) of 72,000kg. Targets could be detected at a distance of 150-180km and the KS-1 launched at an altitude between 4,000 and 5,000m some 70-90km from the target, after which the missile flew towards the target at an altitude of 400m. Production models of the Tu-16KS had the improved Kobal't-P radar.

The Tu-16KS was given the NATO reporting name *Badger-B*.

Tu-16KSR Development Aircraft

The 90-km range of the KS-1 and its subsonic speed soon ceased to satisfy the requirements of the Soviet Air Force which needed a new supersonic missile with a range of up to 150km. Consequently, in the mid-1950s OKB-155 started working on ways of improving on the KS-1, using an improved control and guidance system and a missile propelled by a liquid-fuel rocket motor. On 29th April 1957 MAP issued order No 169 tasking OKB-283 with developing the Rubicon guidance system based on the latest Rubin-1 aircraft radar for the KS and its rocket-powered development, the KSR (*kry-**lah**tyy sna**ryad** ra**ket**nyy* – rocket-propelled winged missile). An experimental form of the system was to be ready for tests by the third quarter of 1957, with Tupolev's OKB-156 charged with preparing the technical documentation for an adaptation of the Tu-16KS by July. Meanwhile, OKB-155 was working on a new rocket-propelled air-to-surface missile.

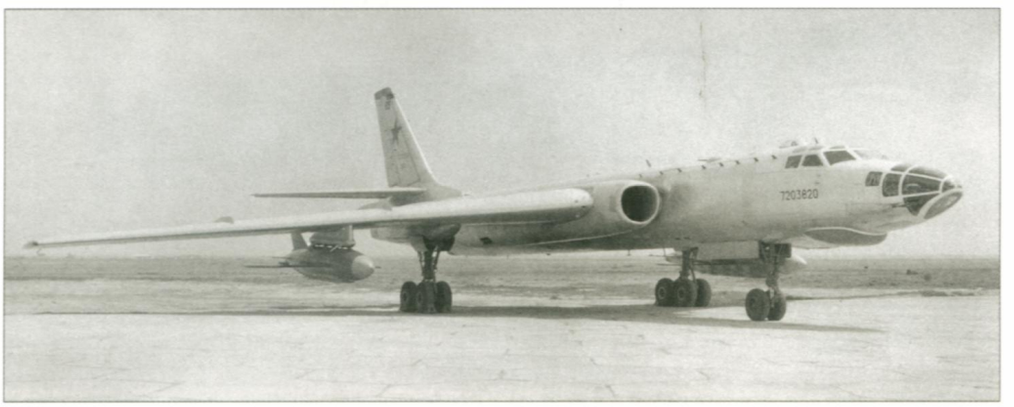
In the autumn of 1958 two examples of the Tu-16 had been fitted with the Rubicon system as 'order 245', one to carry the KS-1 missile and the other the KSR, and sent for trials at Bagherovo range. During the trials held between 1st July and 15th November the experimental Tu-16KSR launched eleven KSR missiles– six against target vessels and five against ground targets with radar reflectors. Out of the six launches against targets ships over a range of 90-96km there were four hits, one miss and one discounted launch due to a failure of the guidance system. The S2.721V liquid-fuel rocket motor designed by Aleksandr M Isayev's OKB proved reliable, igniting without any problems after release at altitudes between 4,000 and 10,000m and speeds between 400 and 500km/h. It functioned as required in two modes: maximum power, with a thrust of 1,200-1,220kg and cruise, with a thrust of 680-700kg, after in-flight ignition.

Tests at altitudes of 4,000-10,000m showed that the new KS-PM guidance radar could detect a ground target at ranges up to 200km and provide stable tracking over distances between 160 and 180km. At a distance of up to 13-15km the missile's own homing radar took over. In launches against maritime targets, detection and acquisition depended on a number of factors, including the type of target and the angle of approach. The results of these tests formed the basis for the development of new air-to-surface missile carrier combinations and for the K-11 and K-16 with their different guidance systems.

The Tu-16KSR-2 (Tu-16K-16) ('order 352E', *izdeliye* NKSR-2 and NK-Z)

The KSR-2 missile, a production derivative of the KSR, was carried by the Tu-16 equipped with the Rubicon guidance system as part of the K-16 complex for use against surface ships, bridges, dams, power stations, factories, rail junctions, airfields and other targets of importance. In May-July 1957 a production Tu-16KS ('49 Red', c/n 7203608/'7124') was converted into the first experimental carrier aircraft for the K-16 complex as the Tu-16KSR-2. State acceptance trials involving the State Committee for Aviation Hardware (GKAT – *Gosoo**dar**stvennyy komi**tet** po aviatsi**on**noy **tekh**nike*), the State Committee for Electronics (GKRE – *Gosoo**dar**stvennyy komi**tet** po **rah**dioelek**tron**ike*) and the State Committee for Defence Technology (GKOT – *Gosoo**dar**stvennyy komi**tet** po obo**ron**noy **tekh**nike*) were held between October 1960 and the end of March 1961. After these the complex was accepted for operational service once the problems thrown up by the trials had been dealt with. (**Note:** In 1957 MAP was 'demoted' to a State Committee along with several other ministries due to changing government policies. The unlucky ones included the Ministry of Electronics Industry (MRP – *Mini**ster**stvo **rah**diotekh**nich**eskoy pro**mysh**lennosti*) and the Ministry of Defence Industry (MOP – *Mini**ster**stvo obo**ron**noy pro**mysh**lennosti*). In 1965, however, their names and status were restored after Nikita S Khruschchov had been unseated and replaced by Leonid I Brezhnev as the Soviet leader.)

The success of the K-16 complex prompted GKAT to propose to the Soviet Ministry of Defence that 100 examples of the Tu-16KS and



The Tu-16KSR-2 prototype, '49 Red' (c/n 7203608/'7124'), seen during trials; note the phototheodolite calibration markings on the forward fuselage. This aircraft survived the break-up of the Soviet Union, becoming Ukrainian Air Force '25 Blue'. Tupolev JSC

Tu-16KSR-2 '65 Blue' (c/n 7203820/'7164') was converted from a Tu-16KS. Note the open exhaust doors for the engine's S-300M turbostarters on the engine housings. Tupolev JSC

Front view of Tu-16KSR-2 c/n 7203820 during State acceptance trials at GK NI VVS. Tupolev JSC

300 Tu-16A bombers should be converted to carry the KSR-2 and equipped with the Rubicon guidance system. It was also suggested that the viability of adapting the supersonic Tu-22 bomber to carry the KSR-2 should also be explored.

On 4th February 1961 the Soviet Council of Ministers issued directive No 117-49 spelling out the performance specification for the K-16 weapons system. This document ordered additional development work and testing to be carried out on the guidance system – particularly the KSR-2's KS-PM radar which was given a larger antenna dish. After passing State trials in July-August 1961 the K-16 system was cleared for service with the Long-Range Aviation and the Naval Air Arm pursuant to CofM directive No 1184-514 of 30th December 1961.

In 1962 work on converting Tu-16KSs to carry two KSR-2 missiles began in DA and AVMF maintenance units. A total of 50 examples was refitted with the K-16 system. Such aircraft were known as 'order 352E' in production (the E denoting a modified Tu-16KS which, as mentioned earlier, was the delivery vehicle for the KS-1, aka *izdeliye* E). The service designation was Tu-16KSR-2 or *izdeliye* NKSR-2; sometimes this version was referred to as the Tu-16K-16 or *izdeliye* NK-3 (although some sources call it 'Tu-16KS-KSR-2').

Also in 1962, the first two operational Tu-16KSR-2s, '65 Red' (c/n 7203820/'7164') and '66 Red' (c/n 5202010), converted from a Tu-16KS and a Tu-16A bomber respectively) underwent checkout trails at GK NII VVS. The two aircraft differed from those tested in 1960 in having a Rubin-1K radar instead of the Rubin-1, a new command link system for working with the missile's KS-1M radar, revised wing pylons for the missiles and so on. Tests continued until the summer of 1964 with intervals for alterations and adjustments, but their successful outcome confirmed the viability of the system and allowed the ways of future development to be outlined. The K-16 system was the first composite aircraft-missile system able to operate both as a missile strike aircraft and as a bomber.

The KSR-2 was a conventional mid-wing monoplane with swept wings and tail surfaces. It was powered by an Isayev S5-6 twin-chamber rocket motor burning TG-02 hypergolic (that is, self-igniting) fuel (called TT-S2 in some documents) and AK-20F oxidiser which provided up to 1,200kg initial thrust and up to 700kg thrust at normal cruising speed. An 840-850kg high-explosive warhead was fitted, but provision was made for fitting a nuclear warhead. Production KSR-2s were 8.62m long, with a wingspan of 4.52m and an all-up weight of 4,077-4,100kg. A maximum speed of 1,260km/h was reached over a flight distance of 120-140km. One or two KSR-2s could be carried and launched either simultaneously or individually. Preparations for launch were the responsibility of the navigator, the automated processes carried out by the Rubicon system making the provision of a WSO (as on the Tu-16KS) unnecessary.

When Tu-16A bombers were converted to Tu-16KSR-2 standard, they retained the capability to carry free-fall nuclear bombs.

The Rubicon-1K radar could detect and select a target at a range of 300-350km. It then passed the information to the missile's own KSPM radar which had been locked on to the target prior to launch. Once the KSPM was receiving a clear signal from the target, the navigator switched over to the missile's own tracking and homing system. Missiles were launched at altitudes between 4,000 and 10,000m at speeds between 700 and 800km/h. After launching its missiles, the Tu-16KSR-2 could turn away from the target thus reducing its vulnerability to enemy anti-aircraft defences. No IFR system was initially fitted to the Tu-16KSR-2.

The following data refers to the K-16 air-to-surface missile system:

Combat radius of the Tu-16KSR-2*	1,900km
Flight altitude of carrier aircraft	4,000-11,000m
Cruising speed with launch at 10,000m	750-800km/h
Target detection range	
towns and large targets	320-340km
large bridges	250-280km
large surface vessels	200-220km
Normal range of KSR-2	120-140km
Maximum range of KSR-2 †	140-150km
Proximity of Tu-16KSR-2 to target	110-130km
'Kill' probability	80%

*with two ASMs, a 75,800-kg AUW, without in-flight refuelling and with 5% fuel reserves.
† from an altitude of 10,000m with the aircraft turning away from the target.

The data below refers to the Tu-16KSR-2 carrier aircraft:

Empty weight	39,200-39,500kg
Maximum TOW with two KSR-2	79,000kg
Fuel load	29,500-30,300kg
Maximum operational range *	3,900km
Endurance at maximum range	5 hours 20 mins
Service ceiling †	11,900m
Time to service ceiling	
with a 62,000-kg take-off weight	37 mins
Time to 10,000m with 62,000-kg TOW	21 mins
Take-off run with two KSR-2s:	
with a 75,800kg take-off weight	2,200m
with a 79,000kg take-off weight	2,400m
Landing run ‡	
with brake parachute	1,200m
without brake parachute	1,600m
Landing run §	
with brake parachute	1,450m
without brake parachute	1,900m

*with 5% fuel reserves on landing and with launch of two KSR-2 at mid-range; † with two KSR-2, a 56,000-kg AUW and a 62,000-kg TOW; ‡ with a 48,000-kg landing weight (after launch of both KSR-2); § with a 57,000-kg landing weight (with both KSR-2 unlaunched).

The Tu-16KSR-2 was given the NATO codename *Badger-G*.

Tu-16KSR-2A (Tu-16A-KSR-2) ('order 352A', *izdeliye* NKSR-2 and NK-Z)

In parallel with the modification of the Tu-16KS and Tu-16KS (ZA) into the Tu-16KSR-2, refits of the Tu-16A and Tu-16 (ZA) were also carried out but their capability as bombers was retained. In this aspect the Tu-16KSR-2A (conversions from the Tu-16A under 'order 352A') differed from the Tu-16KSR-2. Subsequently this difference disappeared when the Tu-16KSR-2 was again modified to carry bombs. The first Tu-16A to be refitted in this way was '66 Red' (c/n 5202010) which, as already mentioned, took part in the checkout State trials in 1962. Under the terms of 'order 352A' 155 examples of the Tu-16A were modified as Tu-16KSR-2A (they were also sometimes referred to as the Tu-16A-KSR-2). Comparatively few Tu-16A and Tu-16KS were converted to Tu-16KSR-2 (Tu-16KSR-2A) configuration in the first half of the 1960s due to the decision to develop the K-11-16 combined system able to use the KSR-2 with active radar homing and the KSR-11 with passive radar homing. In the 1970s the Tu-16KSR-2 and Tu-16KSR-2A were again refitted as the Tu-16KSR-2-5 ('order 386A') as part of the K-26 ASM system.

Tu-16KSR-2 (modified under 'order 684/2')

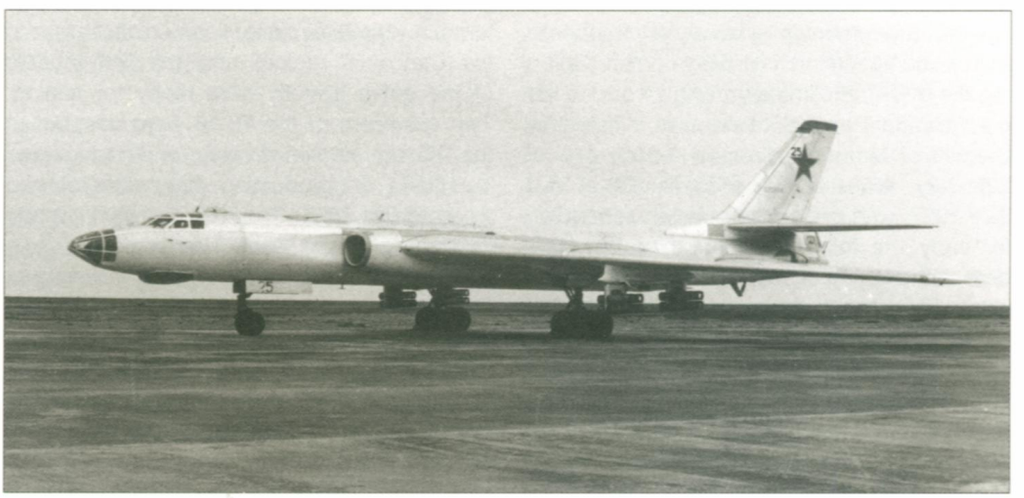
As mentioned above, initially the Tu-16KSR-2 could not carry bombs. However, after modifications under 'order 684/2', free-fall bombs could be carried in the bomb bay as on the Tu-16KSR-2A and the two sub-variants became identical in their capabilities.

Tu-16KSR-2A (modified under 'order 684/1')

The Tu-16KSR-2A was able carry a limited bomb load internally, but it was further modified under the terms of 'order 684/1' to carry bombs externally, bringing its maximum bomb load to 10,000kg,

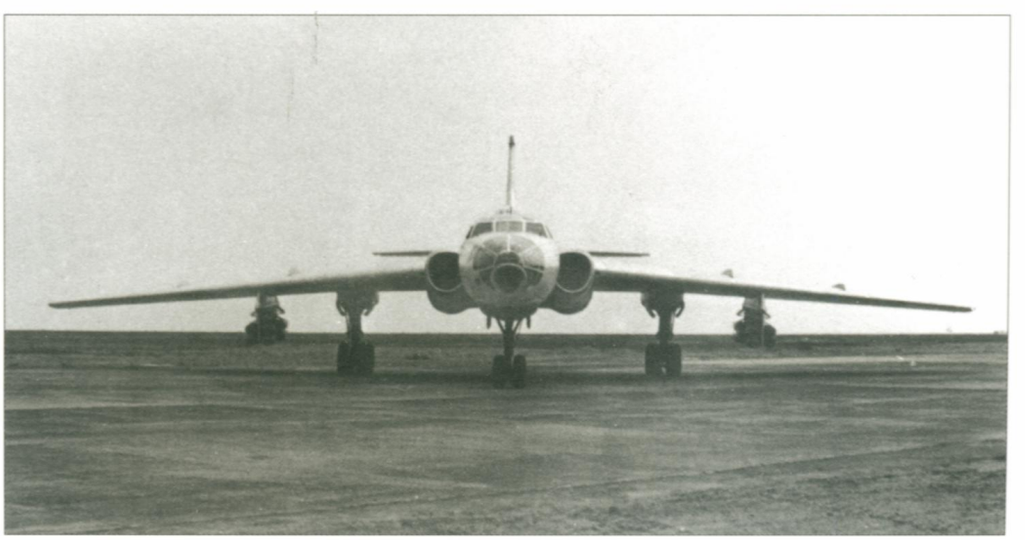
Tu-16KSR-IS

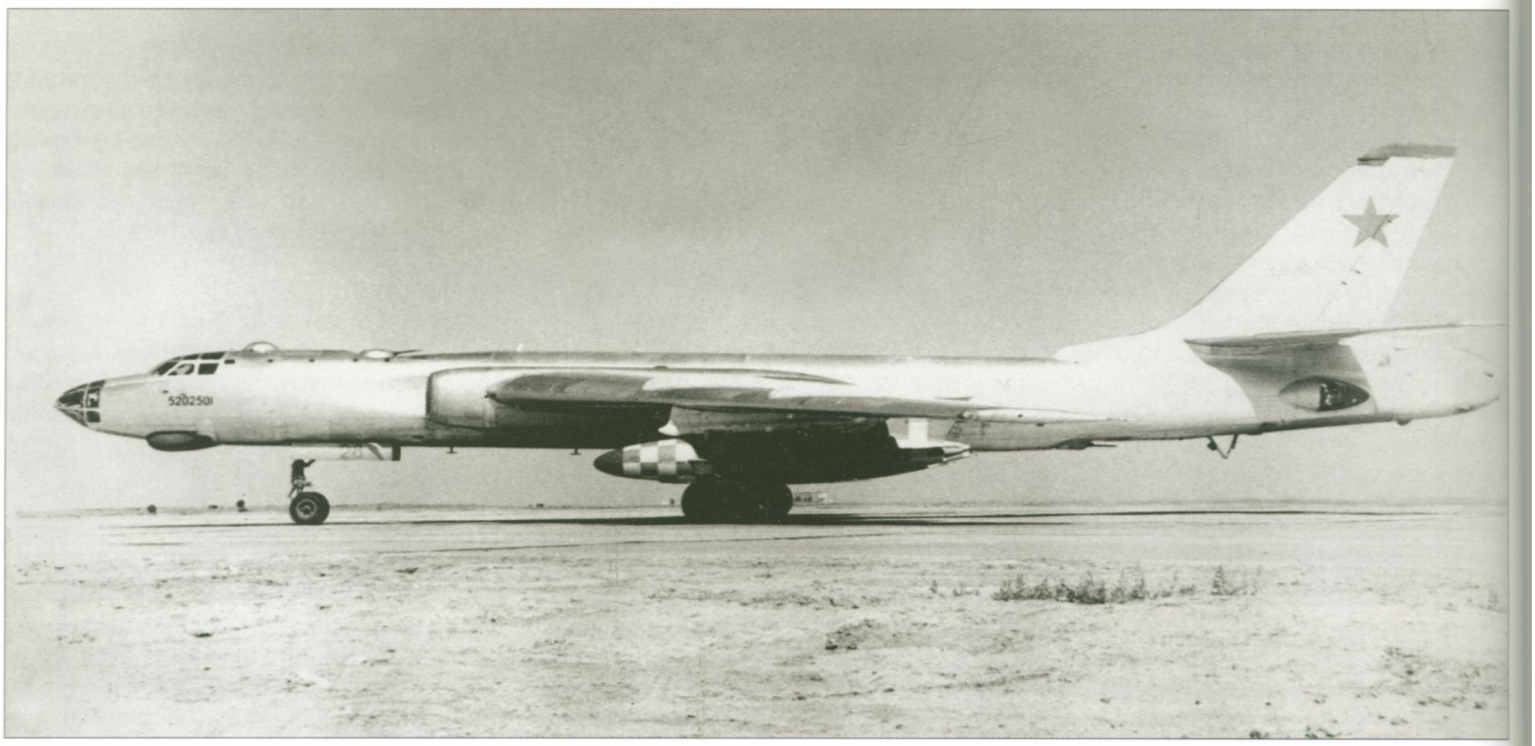
In the early 1970s some Tu-16KSR-2s were fitted with ECM equipment to prevent detection by enemy radars – either for individual protection, using the SPS-5 Fasol' (String bean) active jammer, or for operations as a group, using the SPS-100 Rezeda (Mignonette, pronounced *rezedah*) jammer. The latter was housed in a UKhO ECM fairing. Aircraft equipped with these were designated Tu-16KSR-IS.



Above: **Tu-16KSR-2A '25 Blue' (c/n 5201604) shows off its multiple ejector racks carried on the wing stations. Note Each MER carried eight 250-kg bombs.** Tupolev JSC

Below: **Front view of a Tu-16KSR-2A showing the high-drag external stores.** Tupolev JSC





Tu-16K-11 ('order 285')

Work on the K-11 weapons system was carried out in parallel with the K-16, the KSR-2 being given a passive radar homing system for use against the enemy's ground or shipborne radars and becoming the KSR-11 anti-radiation missile (ARM). Preliminary design work on the K-11 and its Tu-16KS carrier was initiated by Council of Ministers directive No 902-411 of 20th July 1957 and MAP order No 288 of 31st July 1957, with project completion scheduled for early the following year, manufacturer's tests in the spring of 1959 and final trials of the whole complex in the autumn of 1959. The question of updating the K-10 anti-shipping system (see later) with passive radar homing was also to be examined. OKB-156 was to be responsible for work on the Tu-16, the Ministry of Defence's Central Research Institute No 108 (TsNII-108) for the search and target marking system, OKB-155 for the missile and NII-648 for the guidance and passive homing system.

The design work on the K-11 system took two years. By the end of 1959 the basic issues of radar detection and target indication, as well as passive homing, had been solved (the former by the Ritsa system named after a lake in the Caucasus region) and the first models of the entire system were ready for testing. Two examples of the Tu-16 were adapted at the Kazan' aircraft factory and designated Tu-16K-11 (in production they were referred to as 'order 285'). The first Tu-16K-11 made its first flight from Kazan'-Borisoglebskoye in January 1960 and underwent flight testing at Zhukovskiy the following month. In April it was joined by the second Tu-16K-11 and manufacturer's tests of the K-11 began in May. Despite the fundamental design complexity of the system's components, the tests were concluded successfully in the spring of 1962 and the Tu-16K-11 was passed for operational use by CofM directive No 314-157 of 13th April that year.

The K-11 was the first Soviet air-to-surface missile with passive radar homing for use against enemy radars, radar-controlled anti-aircraft defences and surface-to-air missiles. The Tu-16K-11 modified from production Tu-16A and Tu-16ZA bombers could, like the Tu-16KSR-2, also be used as a bomber. It was outwardly identifiable by an inverted T-shaped direction-finder antenna on the extreme nose (on the navigator's station glazing frame). In order to accommodate the Ritsa radar detection/homing system, save weight and keep the CG within prescribed limits the PU-88 fixed forward-firing cannon installation and the PKI gunsight were removed. The KSR-11 hardly differed from the KSR-2 in its design and carried a high-explosive or explosive-fragmentation warhead. At 4,000kg its all-up weight was 100kg less than the KSR-2's due to its lighter guidance system (a 2PRF-10 passive homing radar in a nose radome which increased the missile's length to 8.6m and an AP-72-11 missile autopilot which maintained course between launch and impact). The missile was launched once its radar had locked-on. After launch and ignition, the KSR-11 climbed to the same height as the Tu-16 and maintained that altitude before finally entering a 30° dive to impact. The Tu-16 could carry out any

Tu-16K-11-16 '28 Red' (c/n 5202501), a converted Tu-16A, seen during tests with two red/white chequered KSR-11 missiles. This aircraft has been retrofitted with an SPS-100 active jammer in a boattail fairing supplanting the tail turret. Tupolev JSC

Tu-16K-11-16 '53 Blue' (c/n 4201005) is preserved at the Central Russian Air Force Museum in Monino near Moscow. This illustrates the inverted-T antenna array of the Ritsa radar homing system. Yefim Gordon

Left: **A technician screws a cover plate into place on a Tu-16K-11-16 coded '73' where the fixed forward-firing cannon used to be. This aircraft has had its bomb carrying capability restored under the terms of 'order 684/2', as revealed by the open bomb bay.** Sergey and Dmitriy Komissarov archive

Above: **Sorties were sometimes flown with only a single missile, as this Tu-16K-11-16 illustrates.** Yefim Gordon archive

manoeuvre after launch, including U-turns; the target tracking information was retained by the KSR-11.

The K-11 complex had a 2,000-km combat radius with the aircraft flying at altitudes between 4,000 and 11,000m. Missile launch at 10,000m was effected at a cruising speed 750-800km/h. The radar detection range was 270-350km, with the KSR-11 possessing a range of 160km and a 'kill' probability of 80-90% (the heading memory feature meant that the radar would in all probability be destroyed even if the enemy switched it off).

Although the K-11 system was accepted, it was decided to use the combined K-11 and K-16 for operational use.

Tu-16KSR-2-11 ('order 497A', *izdeliye* NK-11-16 and NK-2)

The high degree of commonality between the KSR-2 and KSR-11 suggested that they could both be fitted to the same carrier. Therefore, in 1962 the K-11-16 complex was accepted for operational use, its Tu-16KSR-2-11 carrier aircraft (equipped with Rubicon 1K and Ritsa guidance systems) carrying either two KSR-2s or KSR-11s, or one KSR-2 and one KSR-11. The maximum range of the KSR-11 was 85km if launched from 4,000m and 120km if launched from 10,000m, with detonation between 4 and 12m above the target. The KSR-2 (with either a HE or a nuclear warhead) had a maximum range of 150km if launched from 10,000m and a minimum range of 70km. The Tu-16KSR-2-11 had an operational radius of 2,050km.

Under the terms of 'order 497A' 155 Tu-16A and Tu-16A (ZA) bombers were converted to Tu-16KSR-2-11 configuration and the Tu-16KSR-2As were modified. In service the Tu-16KSR-2-11 was known as *izdeliye* 'NK-11-16' or *izdeliye* 'NK-2'.

Tu-16K-11-16 ('order 497E', izdeliye NK-11-16 and NK-2)

15 Tu-16KS missile carriers and a number of Tu-16KSR-2s, as well as some Tu-16S SAR aircraft which lacked bomb-carrying capability, were also upgraded to Tu-16K-11-16 standard under the terms of 'order 497' (or 'order 497E' if they carried KS-1 missiles). Initially their ability to carry bombs was not restored, but this was subsequently done on many of these aircraft. In such cases, the underside of the machine was painted white either completely or partly. Conversion of the Tu-16KSR-2 into the Tu-16K-11-16 entailed installation of the Ritsa radar homing system and removal of the nose gun turret and gunsight. The missile pylons could be used for either KSR-2 ASMs or KSR-11 ARMs. Outwardly the Tu-16K-11-16 differed from the Tu-16KSR-2 in having extra skin panels on the weapons bay doors closing the access hatch to the former WSO's cabin and the cutout for the deleted Kobal't-P radar. In addition, the undersurfaces of the machines lacking bomber capability were natural metal. The designation Tu-16K-11-16KS was also sometimes used where the conversion had been from a KS-1 ASM carrier.

A total of 441 Tu-16A, Tu-16 (ZA), Tu-16KS and Tu-16S aircraft were refitted to take the K-16 and K-11-16 weapons systems. Of these, 211 aircraft served with the Air Force and 230 with the Navy. The main delivery vehicle was the Tu-16K-11-16 which was equipped with SPS-5 and SPS-100 ECM sets. Refits were done at maintenance factories in the 1960s. Later, in the 1970s, the Tu-16K-11-16 was modified yet again to Tu-16K-26 configuration.

An air-to-air of a Tu-16KSR-2-11 carrying two K-11 anti-radiation missiles. Note the cutouts in the outboard flaps allowing them to be deployed without striking the missiles' fins. Yefim Gordon archive

A small number of Tu-16K-11-16 were supplied to Egypt and Iraq, taking part in the armed conflicts in the Middle East in the early 1970s and 1980s (the 1973 Arab-Israeli war and the Iran-Iraq war).

The performance of the Tu-16K-11-16 barely differed from the Tu-16KSR-2, although the need to carry two guidance systems increased the former aircraft's empty weight to 40,600kg, necessitating a reduction of the fuel load to 29,000kg. The Tu-16KSR-2-11 and Tu-16K-11-16, as well as the Tu-16KSR-2, were all known by the NATO reporting name *Badger-G*.

Tu-16K-11-16 (modified under 'order 684/2')

At first the Tu-16K-11-16 lacked bomber capability, but after modification under the terms of 'order 684/2' it could carry a full bomb load of up to 13,000kg comprising 40 FAB-100 or FAB-250 bombs, or 26 FAB-500s, or four FAB-1500s, or two FAB-3000s, or eight torpedoes (four in the bomb bay and four on underwing pylons).

K-26 long-range stand-off ASM System

Design work on the new K-26 air-to-surface missile system built around the improved Rubicon-1KV radar and the new KSR-5 ASM was initiated by Council of Ministers directive No 838-357 of 11th August 1962. The system was to comprise either the Tu-16K-26 or Tu-16KSR-2-5 or Tu-16KSR-2-5-11 as a carrier, two KSR-5 (with conventional or nuclear warheads), KSR-2 or KSR-11 ASMs, and the Vzlyot (Take-off) guidance system.

The KSR-5 was developed by OKB-2-155 (the missile branch of the Mikoyan OKB) during the late 1950s and early 1960s; its design benefited from the experience gained with the KS-1, KSR-2 and KSR-11 missiles, as well as with the Kh-22 for the supersonic Tu-22K. It was devised as a highly accurate delta-wing 'fire-and-forget' missile for use against ground or maritime targets. The missile was powered by a S5.35 three-chamber rocket engine designed by the Isayev OKB and equipped with a VS-K active radar homing system, proving superior to all preceding Soviet air-to-surface missiles. With a length of 10.56m, a wing span of 2.6m and a launch weight of 3,900kg, the KSR-5 had a maximum speed of 2,500-3,000km/h and a flight altitude of 22,000-25,000m. Its range from low-altitude launch was 200-240km, but up to 500km if launched at a higher altitude. The KSR-5 could carry either a high-explosive warhead which detonated on impact with the target or a nuclear warhead set for a predetermined height Later developments included the KSR-5P, KSR-5M, KSR-5B and KSR-5N, as well as the D-5NM (MV) target drone.

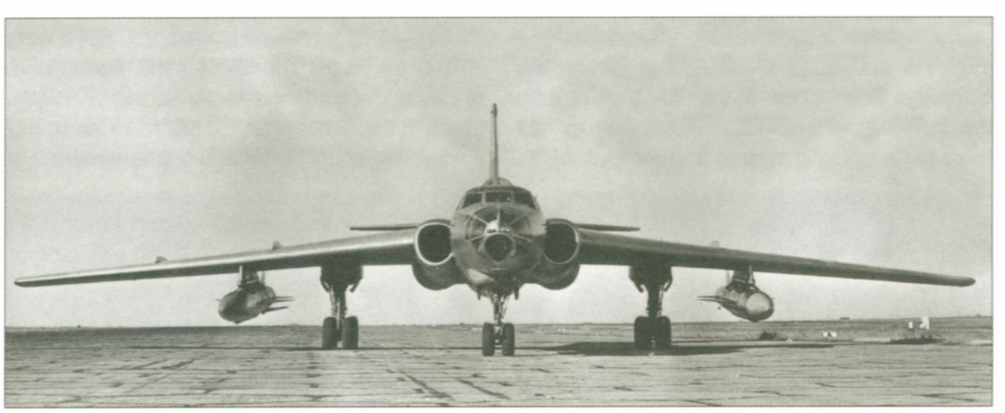
Flight tests and State trials of the K-26 complex were held between October 1964 and December 1967, using two machines, a Tu-16K-26 and a Tu-16KSR-2-5, modified from Tu-16K-11-16KS '54 Red' (c/n 8204022/'8191') and Tu-16KSR-2A '66 Red' (c/n 5202010) respectively. During this first stage 82 flights and ten launches of the KSR-5 were made, five of these to test the missile's active homing system. Data derived from the tests recorded that the K-26 system had an operational radius of 2,100km with two KSR-5; the missiles were launched with the carrier cruising at 750-800km/h at an altitude of 10,000m. The maximum range of the KSR-5 was between 200 and 240km.

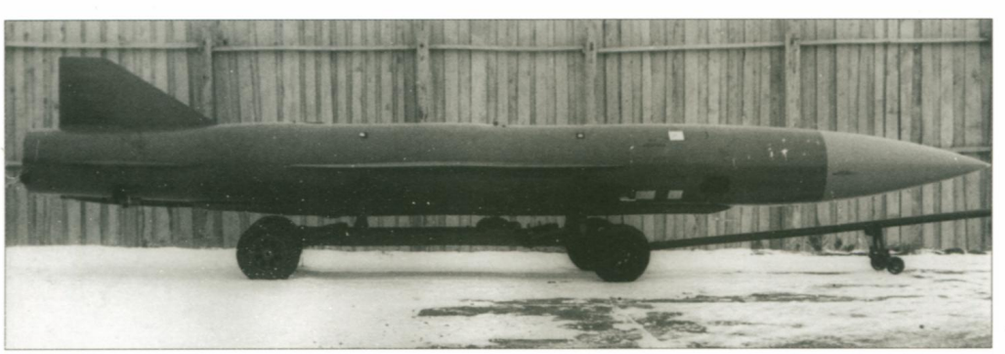
A second round of state trials began in January 1968 and went on for almost eleven months. The Tu-16K-26 and Tu-16KSR-2-5 made 87 flights totalling 288 hours; in order to speed up the trials they were later joined by Tu-16K-26 c/n 4200703 and Tu-16K-10-26 '15 Red' (c/n 1793014). A total of 13 KSR-5s were launched at ground and maritime targets.

The K-26 system was accepted by the Long Range Aviation and Naval Air Arm pursuant to CofM directive No 882-315 of 12th November 1969. The Tu-16K-26, Tu-16KSR-2-5 and Tu-16KSR-2-5-11 were all known by the NATO reporting name *Badger-G Mod*.

Tu-16K-26 ASM Carrier ('order 386', *izdeliye* NK-26 and NK-4)

Fifteen examples of the Tu-16K-11-16KS were modified into Tu-16K-26 missile-carriers. In service they were referred to as *izdeliye* NK-26 or *izdeliye* NK-4, and during conversion as 'order 386'. The Tu-16K-26 differed from the Tu-16K-11-16 only in its new ASMs and the equipment and adaptations required to carry them. The prototype was converted from a Tu-16K-11-16 coded '54 Red' (c/n 8204022/'8191'). Conversion work in air force repair and maintenance units began in 1969.





'54 Red' (c/n 8204022/'8191'), the Tu-16K-26 prototype, at GK NI VVS during State acceptance trials. The sleek KSR-5 missiles make a striking contrast with the ASMs carried by the Tu-16 hitherto. Tupolev JSC

Front view of the Tu-16K-26 prototype. Note how the missiles' ventral fins fold to provide adequate ground clearance. Tupolev JSC

A KSR-5 missile on its ground handling dolly. This is a red-painted inert missile. Tupolev JSC

The forward fuselage of the Tu-16K-26 prototype; the aircraft received white undersurfaces late in its flying career. The picture was probably taken at the Air Force Institute in Kiev where the aircraft ended up as a ground instructional airframe. Yefim Gordon archive

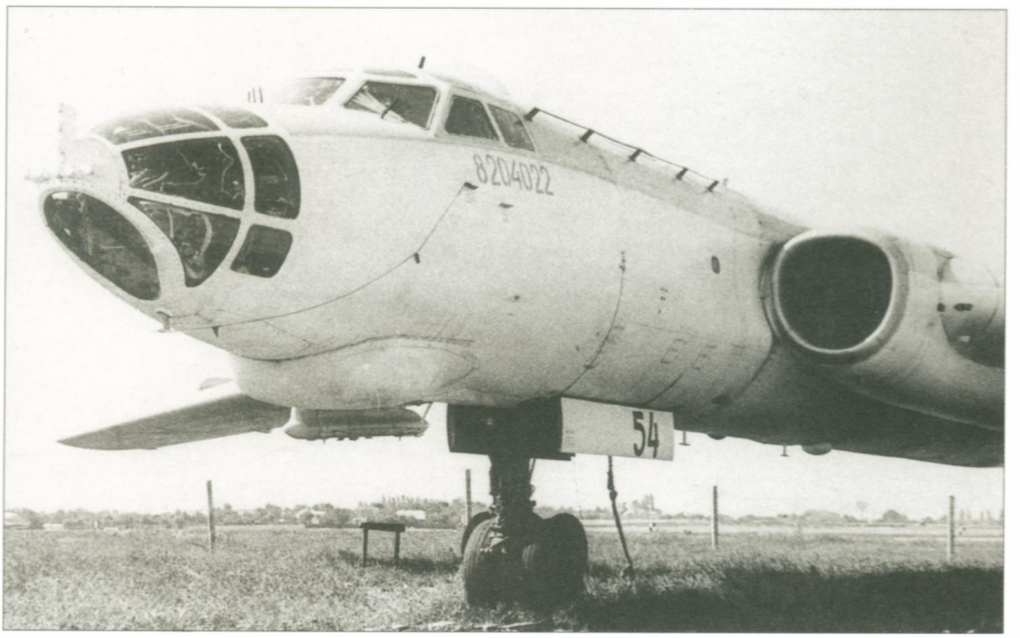
The data below refers to the Tu-16K-26:

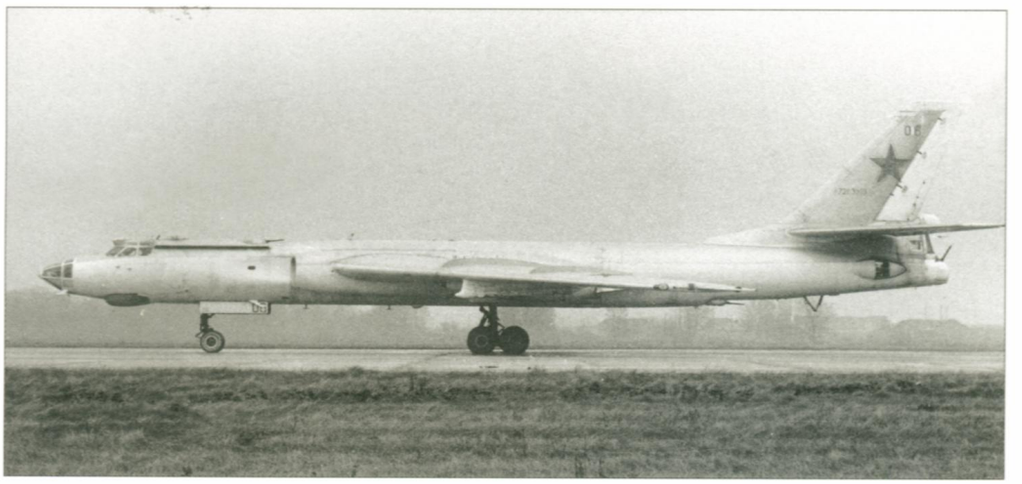
Empty weight	39,480kg
Take-off weight	
normal	75,800kg
max (exceptional combat conditions)	79,000kg
Fuel load	43,800 litres
Maximum speed*	
at up to 500m	550km/h
at 6,000m	720km/h
at 8,000m	820km/h
at 10,000m	900km/h
Maximum permissible Mach number	0.88
Service ceiling †	12,300m
Operational range ‡	4,800km
Combat radius with a speed corresponding to Mach 0.72	2,150-2,180km

* at full engine power and carrying one or two ASMs; † with one or two ASMs, a 62,000-kg TOW and engines at nominal power; ‡ at optimum altitude with a normal AUW, one ASM launched at midpoint and landing with 5% fuel reserves.

The Tu-16K-26 could carry one or two KSR-2, KSR-5 or KSR-11, or a single missile plus a conventional bomb or nuclear weapon load up to 4,000kg. Modernised versions of the KSR-5 were later used on upgraded carriers: the KSR-5M on the Tu-16K-26M (K-26M complex), the low-level KSR-5N on the Tu-16K-26N (K-26N complex) and the low-level KSR-5NM target-drone.

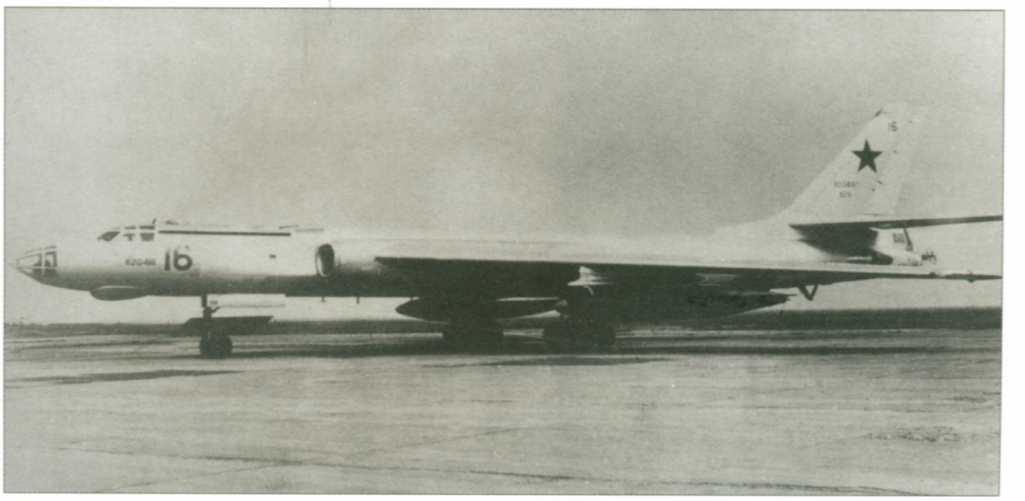
Tu-16KSR-2-5-11
('order 386A', *izdeliye* NKSR-2-5-11 & NK-5)
Under the terms of 'order 386A' 125 examples of the Tu-16KSR-2-11 (which retained bomber capability) were equipped as K-26 complexes in a similar way to the Tu-16K-26, carrying a pair of KSR-2, KSR-11 or KSR-5 missiles of various subtypes (excluding the KSR-5P). Outwardly they differed from the Tu-16K-26 in lacking the panels on the rear sections of the bomb bay doors and the white-painted undersurfaces. This modification became one of the standard missile-carrying versions of the Tu-16.





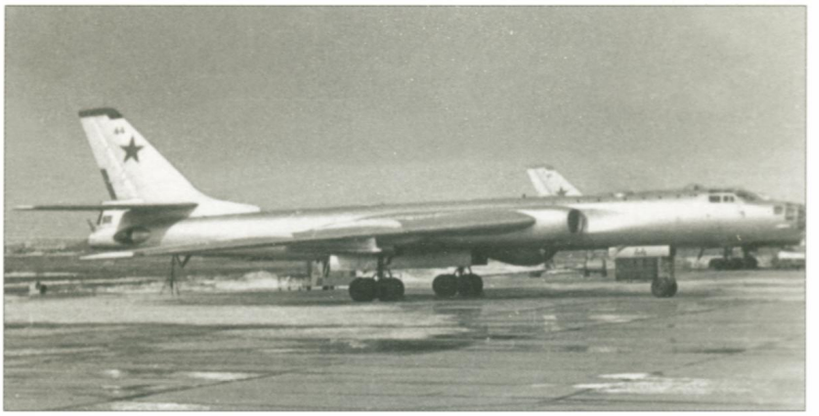
Tu-16KSR-2-5
('order 386A', *izdeliye* NKSR-2-5 and NK-5)
One hundred and ten examples of the Tu-16KSR-2A were also converted for the K-26 system under the terms of 'order 386A', analogous to the conversions of the Tu-16K-11-16KS into the Tu-16K-26 and the Tu-16KSR-2-11 into the Tu-16KSR-2-5-11. The Rubin-Ritsa link equipment was not installed. The Tu-16KSR-2-5 could be used as a bomber and carried two KSR-2 or KSR-5 missiles of various subtypes (including the KSR-5NM target drone). Unlike the two preceding modifications, the Tu-16K-26 and Tu-16KSR-2-5-11, it was not equipped to carry the KSR-11 or KSR-5P anti-shipping missiles.

The equipment fitted on the Tu-16KSR-2-5 differed from that on the Tu-16K-26 in that it included a PKI reflector sight, an SP-50 blind landing system, and later an active ECM capability consisting of a SPS-5M and SPS-151/152/153 from the Siren' (Lilac, pronounced *see**ren**'*) complex. But the reconnaissance, and target-indicating equipment and the bombsight were omitted (although some



Above centre: **Tu-16K-26 '06 Red' (c/n 7203819) was converted from Tu-16KS '24 Red'. Once again the aircraft has gained white undersurfaces and ECM equipment for self-protection; the additional number '7163' is no longer carried on the tail.** Yefim Gordon archive

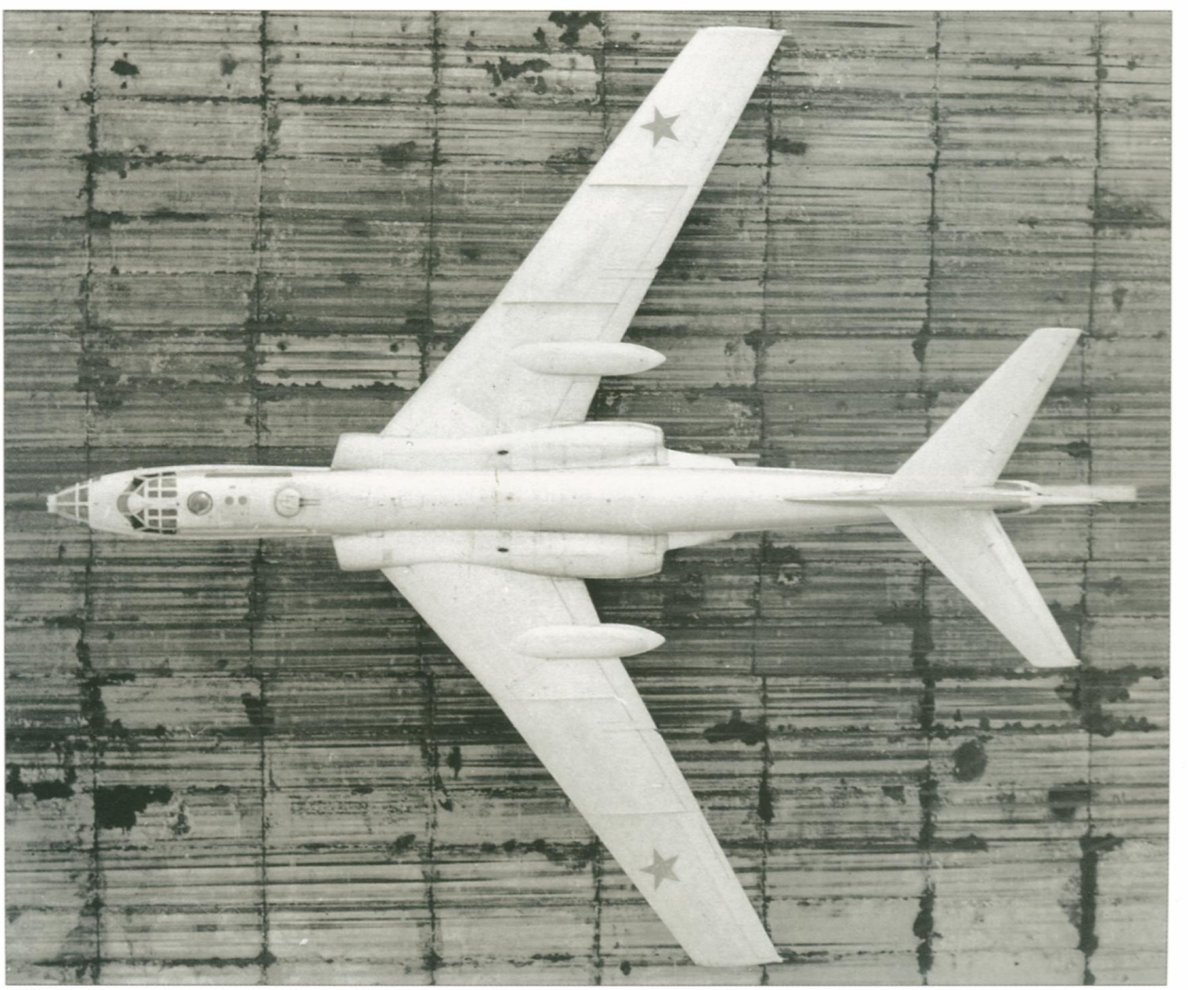
Right: **'16 Red' (c/n 8204111/'8211'), the Tu-16KSR-2-5 prototype, carrying a pair of KSR-2s in this case. Note the figure-eight shaped aerial on the tail guns (probably associated with a data link system).** Tupolev JSC



Above left and right: **'44 Red', a Tu-16K-26 with a Rubin-1M radar, rests between missions. Note the open bomb bay.** Yefim Gordon archive

Tu-16K-26 '72 Blue' (c/n 6203001) was converted from a Tu-16A bomber, hence the white undersides. Note the faired ventral anti-collision light on the starboard nosewheel door, a feature added to most Tu-16s in service. Yefim Gordon archive

This upper view of a Tu-16K-26 illustrates the wing planform with the slightly kinked leading edge near the inboard wing fences, the sharper sweep of the horizontal tail and the engine nacelle tail fairings. Yefim Gordon archive



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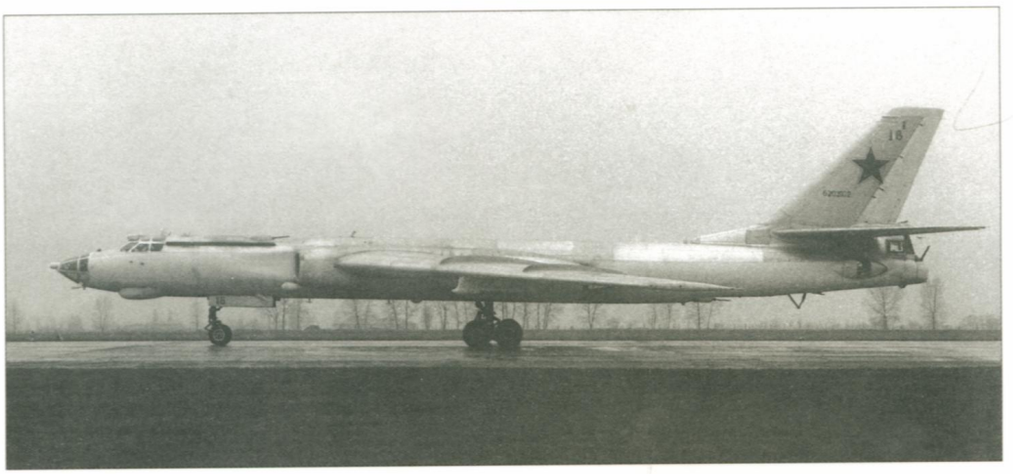
Left: **Some Tu-16K-26s were fitted with the Rubin-1M radar in a large teardrop radome under the centre fuselage instead of the usual chin radome housing an RBP-4 radar. This example carrying a single KSR-5 was intercepted by NATO fighters over the Baltic Sea.** Yefim Gordon archive

Right: **A Tu-16K-26 with a Rubin-1M radar prepares to make contact with a Tu-16(Z) tanker.** Yefim Gordon archive



mised for low-level operations. A small number of Tu-16K-26s, Tu-16K-26Ps, Tu-16KSR-2-5s and Tu-16KSR-2-5-11s were updated to Tu-16-26N configuration in accordance with 'order 2226' and served with the Naval Air Arm in the 1980s. If the KSR-5N was used by the already mentioned versions without modification, it was launched at the same altitude as the KSR-5, subsequently descending to its designated flight altitude to enable stealthy approach to the target.

Tu-16K-26P ('order 397', *izdeliye* NK-26P)

Developed in accordance with Council of Ministers directive No 123-43 of 7th February 1964, this system was designed around the KSR-5P anti-radiation missile with passive radar homing (P = ***pro****tivolokatsi****on****naya* [*ra****ket****a*] – ARM). It used a Tu-16KSR-2-5-11 equipped with the Plot (Raft) compatible passive radar homing/guidance system as the carrier aircraft which received the designation Tu-16K-26P. The two missiles could be launched against the same target or different targets (one of which, however, had to be in line with the aircraft's line of flight), after which the aircraft was able to turn away. The standard K-26 equipment fit was retained so that KSR-5, KSR-2 or KSR-11 missiles could be carried. Only the Siren' jammer was omitted.

The experimental Tu-16K-26P ('order 397') began its factory tests in the summer of 1967 with State trials commencing in April 1972. On 4th September 1973 the K-26P system was cleared for Soviet Navy service by Council of Ministers directive No 643-205. Conversions of Tu-16KSR-2-5-11s to the new standard were carried out at Naval Air Arm repair and maintenance bases. The following data refer to the K-26P system:

Max operational range*	
with 5% of fuel remaining on landing:	
with a TOW of 75,800kg	2,240km
with a TOW of 79,000kg	2,400km
with 10% of fuel remaining on landing:	
with a TOW of 75,800kg	2,130km
with a TOW of 79,000kg	2,330km
Missiles launched between	9,000-11,000m
Range of missile	
maximum (with launch at 11,000m)	330km
minimum (with launch at 9,000m)	100km
Average speed of KSR-5P over flight	3,000km/h
Impact speed of missile	450m/sec

* Tu-16K-26P carrying two KSR-5P ASMs at optimum altitudes, without IFR, with missile launch at a distance of 330km from the target.

Tu-16K-26PM (*izdeliye* NK-26PM)

Aircraft brought up to K-26PM standard and carrying KSR-5M and KSR-11 missiles were designated Tu-16K-26PM or *izdeliye* NK-26PM and were equipped with the AMP-M communicator linking the aircraft and missile radars.

Tu-16K-26B (*izdeliye* NK-26B)

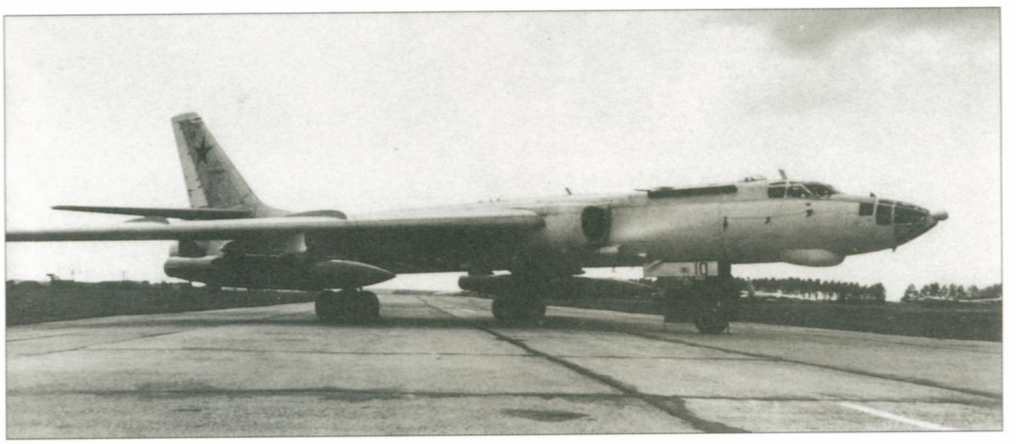
This was a sub-variant of the Tu-16K-26 modified under the terms of 'order 684/2' to carry a greater load of bombs or mines carried both internally and externally. The B referred to the bomb armament (*bombardi****rov****ochnoye vo'oroo****zheni****ye*).

Tu-16K-25-07

One more sub-variant of the Tu-16K-26 fitted with an L007 active jammer for individual protection was designated Tu-16K-25-07.

Tu-16K-22 Development Aircraft ('order 294/3')

This was a service example of a Tu-16 ASM carrier fitted with test instrumentation and used to carry and launch the Kh-22 ASM during tests of the Kh-22 complex designed by KB-1. It served successfully for several years during the development of the Kh-22 ASM and its Tu-22K, Tu-22M and Tu-95K-22 carriers.



Later in their service lives many Tu-16K-26s were updated to Tu-16K-26P standard with characteristic ECM antenna fairings at the tip of the nose and under the air intake trunks. Tu-16K-26P c/n 6203102 has an identity crisis, wearing the code '16 Blue' on the nose gear doors and '18 Blue' on the fin! Yefim Gordon archive

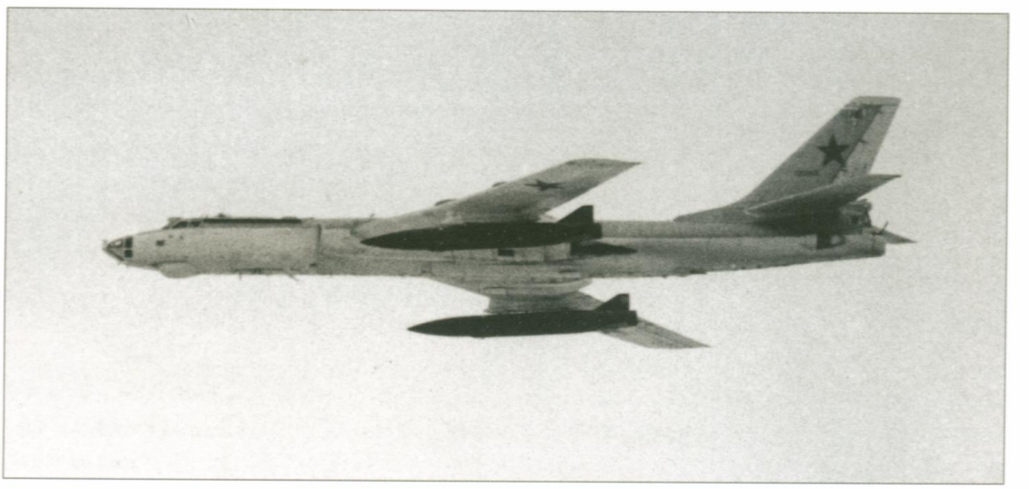
Tu-16K-26P '66 Red' (c/n 7203614) with two KSR-5 missiles has been prepared for a display, as the data placard near the nose gear indicates. Yefim Gordon archive

Front view of a Tu-16K-26P. Yefim Gordon archive

A pair of fully armed Tu-16K-26Ps led by '71 Red' (c/n 7203605) makes a demonstration flypast. Yefim Gordon

Another shot of Tu-16K-26P '71 Red' (c/n 7203605) as it stages its show performance. Yefim Gordon

This cutaway drawing of the Tu-16K-10 illustrates the trademark nose radar arrangement, the semi-recessed K-10S missile and the missile launch operator's cabin in the weapons bay just aft of it. Tupolev JSC



Tu-16 ASM Carriers with Restored and Increased Bombing Capability (Tu-16KSR-2, Tu-16KSR-2A, Tu-16K-11-16, Tu-16K-26 and Tu-16KSR-2-5 modified under 'order 684/1' and 'order 684/2')

In the late 1960s it was decided to expand the tactical capabilities of the Tu-16 by refitting some of the missile-toting versions with restored and increased bomb carrying facilities. In 1969 Tu-16KSR-2-5 c/n 6203130 was selected for modification in this way by the Naval Air Arm's Engineering Service, and successful GK NII VVS tests of the aircraft were held in June and July the following year. With provision for carrying these munitions externally as well as in the bomb bay, the machine could carry 3,000kg of bombs or mines weighing between 500 and 1,500kg (maximum bomb/mine load 9,000kg) in addition to its ASMs.

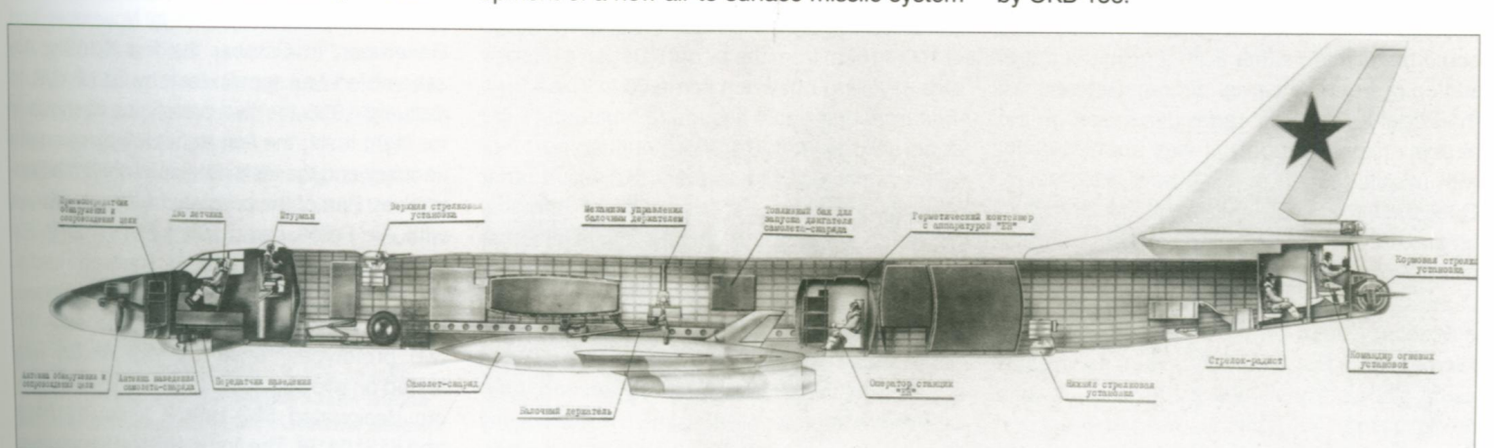
Almost simultaneously, between March and June 1970, GK NII VVS carried out trials on Tu-16KSR-2A c/n 5201604 refitted at plant No 22 in Kazan' (referred to as the Tu-16A-KSR-2 in documents) with increased bomb loads of up to 13,000kg, 4,000kg of which was carried externally. The aircraft attained a maximum speed of 820km/h at 7,550m and had a service ceiling of 11,100m, with a take-off weight of 60,000kg. At optimum altitudes and with a 13,000kg bomb load the aircraft had a maximum operational range of 2,820km with a maximum weight of 79,000kg and 2,400km with a weight of 75,800kg.

In comparison with the original Tu-16KSR-2 carrying two KSR-2 missiles, the range with a 13,000kg bomb load and with a normal take-off weight of 75,800kg was reduced by 1,430km due to the smaller fuel load and increased fuel consumption.

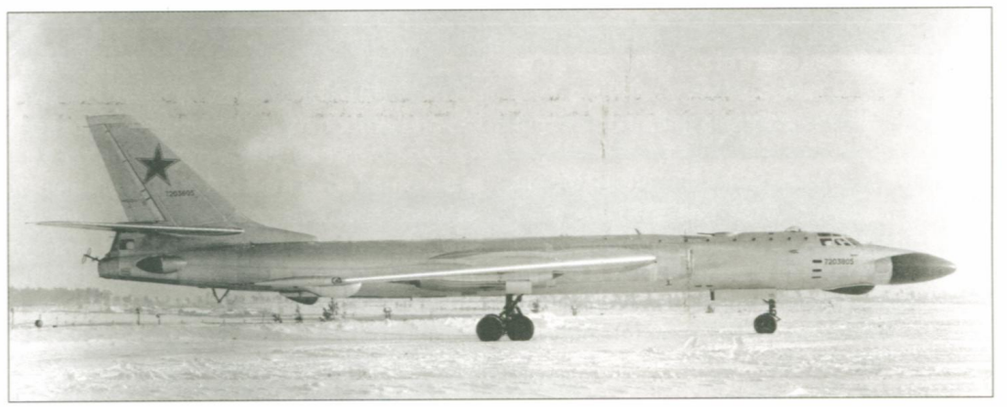
On the basis of the tests carried out on these two aircraft, work on restoring the bomber capability (as per 'order 684/2') was carried out by repair and maintenance factories on the Tu-16KSR-2, Tu-16K-11-16, Tu-16K-26 and Tu-16KSR-2-5, and on increasing bomb carrying capability (as per 'order 684/1') on the Tu-16A, Tu-16KSR-2A and Tu-16KSR-2-11.

Tu-16K-10 ('order 238', *izdeliye* NK-10, *izdeliye* NK-1)

In the early 1950s Mikoyan's OKB-155 and Tupolev's OKB-156 co-operated in the development of a new air-to-surface missile system based on the Kometa. This was to be the K-10S which, unlike the KS-1, would be supersonic, possess a significantly greater range and a 150% improvement in accuracy. Its primary targets were to be vessels with a displacement in excess of 10,000 tonnes. A new guidance system, the K-10U. was devised by a team led by S F Matviyevskiy based on the YeN airborne radar. The work on the new system was kicked off by CofM directives No 178-110 of 3rd February 1955 and No 1946-1045 of 16th November 1955; plant No 22 in Kazan' was charged with modifying a Tu-16 into the prototype of a new missile carrier designated Tu-16K-10, using drawings supplied by OKB-156.



The first prototype Tu-16K-10 (c/n 7203805) during manufacturer's flight tests. The huge 'snout' is plainly visible. Tupolev JSC



A side view of the first prototype Tu-16K-10 with no missile. Note the telemetry data link (?) aerial supplanting the tail guns, the ventral blister fairing supplanting the ventral gun barbette and the teardrop fairing under the starboard wingtip; the latter houses a cine camera to record missile launches during trials. Tupolev JSC

The same aircraft with a K-10S missile in stowed position, the way it is during take-off and cruise flight. Tupolev JSC

The K-10S had a mid-set wing swept back 55° and tail surfaces with 55°30' sweepback. Some examples had a ventral fin. The missile had a shaped-charge/high-explosive warhead, either the FK-1O ('one-o') or FK-1M – the latter for striking large naval vessels below the waterline. Nuclear warheads could also be used. Propulsion was by a Mikulin M-9FK afterburning turbojet, a disposable short-life version of the RD-9B fitted to the MiG-19 fighter. Launch and guidance were semi-autonomous and could be effected either from a ground control station or from the carrier aircraft. Detection of the target by the YeN radar depended on the aircraft's flight altitude but was about 480km, with missile launch at a range of 120-270km. Once the target was detected, the radar locked on and the automatic tracking system was activated. After launch the K-10S entered the beam of the aircraft's radar and was guided by it. The guidance system on the missile consisted of two parts: the first (YeS-2D) guided the missile, using signals transmitted by the aircraft, and made altitude corrections, while the second (YeS-1) comprised the missile's own active radar homing and command system as it came within a pre-set range of the target. The missile was also equipped with YeS-3A autopilot. (In the designations of the guidance system's components, N stood for *no**sit**el'* – carrier [aircraft] and S for *sna**ryad*** – missile.)

An attribute of the K-10S was that the missile manoeuvred in both horizontal and vertical planes en route to the target. After launch, the missile lost height slightly, then flew straight as it entered the aircraft's radar beam. At a range of 100-110km from the target it began a shallow dive, levelling out when some 60 to 70km from the target and again assuming horizontal flight at an altitude of 800-1,000m until some 10 or 16km remained; at this point the active radar homing system was activated for terminal guidance. Impact was at very low level either above or below the target vessel's waterline. The missile's vulnerability to anti-aircraft defences was reduced by its speed, relatively small radar signature and the brief period in which its homing radar could be jammed. After launch the aircraft could make an 80° turn away from the target (the K-10S then followed a horizontally curved flight path); this considerably increased the minimum distance between aircraft and target (to 110-150km), minimising the risk that the aircraft should come within range of the enemy air defences.

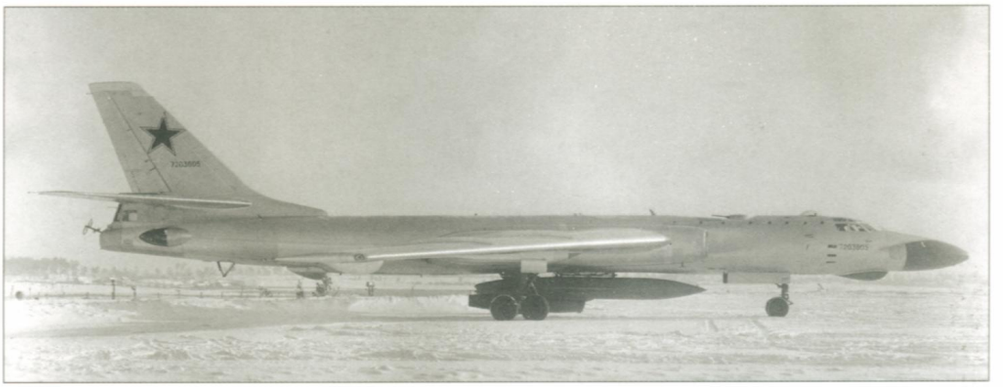
Design of the Tu-16K-10 carrier to Naval Air Arm requirements began in December 1956 and was based on the Tu-16 bomber, drawing on the experience acquired during the development of the Tu-16KS. The Tu-16K-10 was optimised for attacking naval targets. The big YeN radar occupying the place of the usual glazed nose (the navigator's station was moved aft) had two antennas – one for the search/target illumination channel and one for the missile's command link channel. While the latter antenna could be accommodated in a neat teardrop-shaped chin radome without any problems, the main antenna was too large to fit inside the fuselage nose. As a result, the Tu-16K-10 received a distinctive nose profile with a 'duck bill' radome that was wider than the fuselage. The work on fitting the YeN radar and modifying the weapons bay to accommodate the large semi-recessed missile was carried out by the equipment section of OKB-156 headed by A V Nadashkevich. Before launch the K-10S had to be lowered clear of the fuselage on a hydraulically actuated centreline pylon and its engine started; after launch the inwards-opening weapons bay doors were closed pneumatically. The special door/pylon design meant that the Tu-16K-10 could not carry bombs or mines, and no strike cameras were fitted.

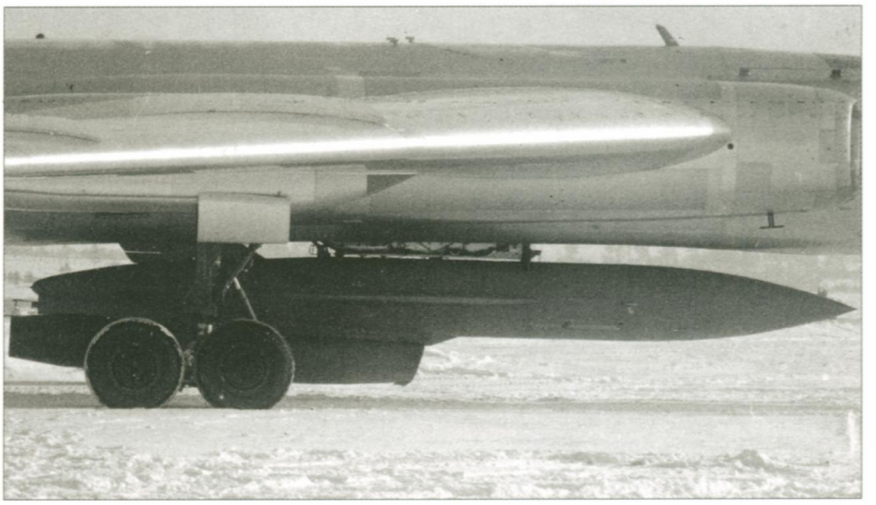
In 1957 OKB-156 passed the conversion documents to plant No 22 in Kazan', where the first two Tu-16K-10 prototypes (converted from brand-new Tu-16s with the c/ns 7203805 and 7203806) were completed in November and December. In October the first K-10S to be assembled was sent for tests by GK NII VVS. In January 1958 the two prototypes were ready for flight tests; the first flight took place on 4th January and the tests continued until 29th September. Part of the programme was performed with Air Force participation at GK NII VVS's main facility in Akhtoobinsk, southern Russia. Before the State acceptance trials had started, the YeN radar was put through its paces on the two prototypes, while the YeS system was tested on two specially modified MiG-19S fighters designated MiG-19SMK (c/ns 61210418 and 61210419). The first K-10S test launch from

This view of the first prototype Tu-16K-10 shows how the missile is lowered clear of the fuselage before engine starting and launch. Tupolev JSC

Below left: **Close-up of the rear end of Tu-16K-10 c/n 7203805, showing the assorted antennas and fairings associated with test equipment.** Tupolev JSC

Below right: **Close-up of the K-10S missile in fully lowered position, showing the hefty BD-238 hydraulically retractable centreline pylon. Note that the missile's fin is still partially inside the weapons bay.** Tupolev JSC





a Tu-16K-10 prototype in autonomous mode (without using the guidance and homing systems) was made on 28th May 1958, and on 21st November the Tu-16K-10 prototypes were submitted for State trials.

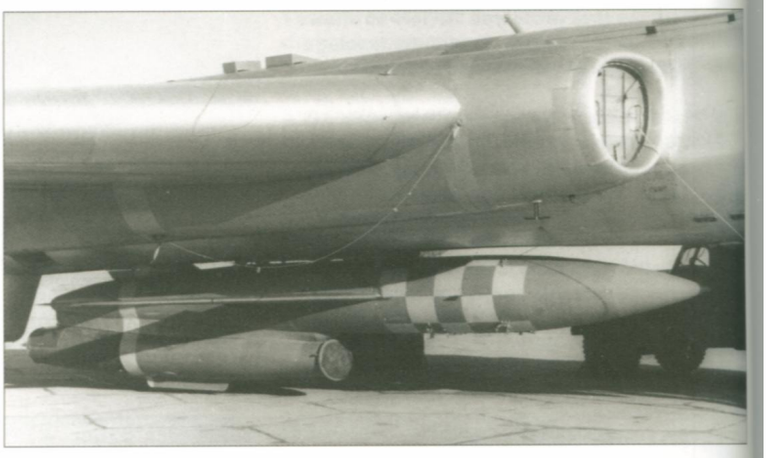
Combined state trials of the Tu-16K-10, the K-10S missile and the K-10 system as a whole were conducted by GK NII VVS over almost three years over various phases of development and with interruptions for further modifications and trials of the system's components. The last phase involved its operation in an active ECM environment. After the first test launch in May, five more were made between June and September 1958 against small radar-reflecting ground targets over a range of 96km by a test crew headed by Hero of the Soviet Union Lt Col V V Zentsov. Four hits were achieved. Overall in 1958, during manufacturer's tests and joint State trials, six missiles were fired, four of which hit their targets.

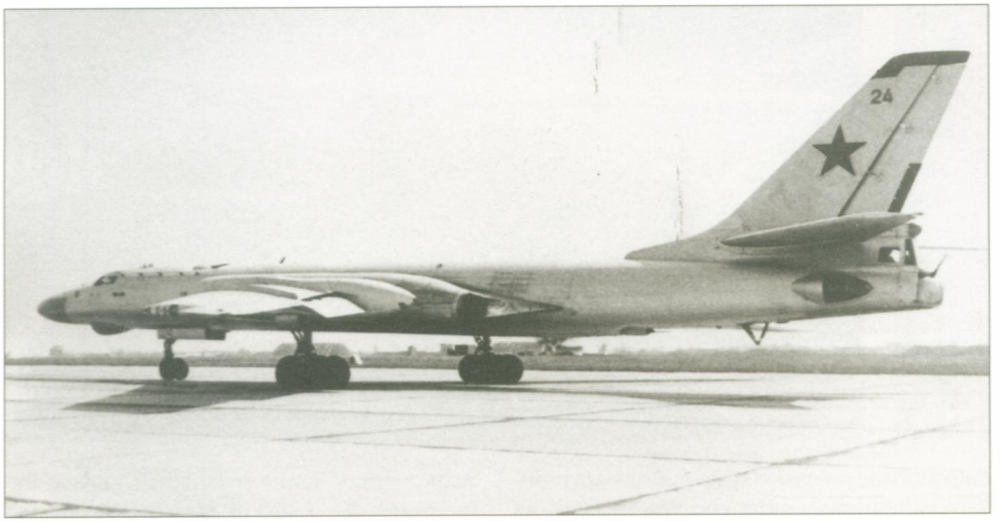
Ten more K-10S were launched in 1959 as the joint State trials continued. These confirmed the safety of missile separation; the ability of the aircraft to land with the missile still in place was also verified.

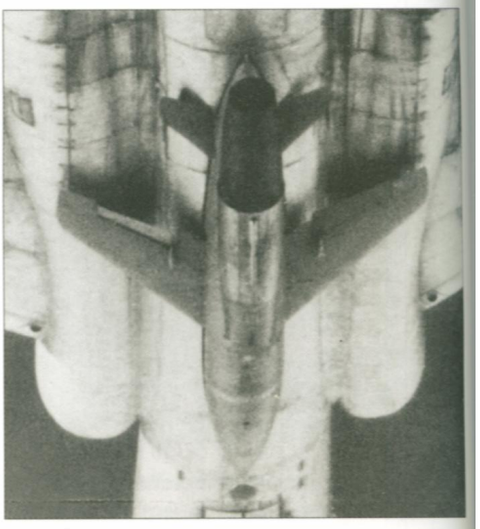
The trials also revealed the impossibility of achieving any substantial increase in the missile's range (compared to the KS-1) due to defects in the guidance system. Constant problems with the YeN radar and YeS receiver, as well as with the missile's engine, resulted in all five test launches at a range of 130-150km ending in failure. There were also problems with the aircraft's fuel system when subjected to G loads for prolonged periods. Thus, by early 1960, only six hits had been recorded.

Council of Ministers directive No 1475-685 ordering the K-10 system into production was issued on 31st December 1958, with production of the K-10S missile allocated to aircraft factory No 31 in Tbilisi. However, by this time the K-22 complex based on the supersonic 'aircraft 105' bomber (Tu-22) and the Kh-22 ASM seemed to offer more promise. The K-10S was thus intended mainly for the obsolescent Tu-16 which looked set to be taken out of production soon; it was planned to replace the Tu-16 with the Tu-22 at plant No 22 and the An-10 at plant 64 Voronezh. Nevertheless, series production of the Tu-16K-10 was initiated in Kazan'. The first production Tu-16K-10 (c/n 8204010) was rolled out at plant No 22 in April 1958, and a mere five Tu-16K-10 (ZA) aircraft featuring the wing-to-wing IFR system were built in 1958-59, whereupon Tu-16 production in Kazan' was suspended to free up production capacity for the Tu-22. Later, in October 1959, the Tu-16K-10 entered production at plant No 1 at Kuibyshev in accordance with CofM directive No 709-337 of 2nd July 1958. During production the Tu-16K-10 was designated 'order 238' and later, in operational service, as *izdeliye* NK-10 or *izdeliye* NK-1.

The likewise uncoded second prototype Tu-16K-10 (c/n 7203806) with a K-10S missile. This aircraft has a similar ventral blister but no cine camera fairing under the starboard wingtip. Tupolev JSC







Top left: **An inert K-10S missile bedecked with photo calibration markings on a ground handling dolly.** Tupolev JSC

Top right: **The same missile suspended beneath one of the Tu-16K-10 prototypes. Note the large size of the engine pod in relation to the fuselage and the open entry hatch of the missile launch operator's cabin.** Tupolev JSC

Above left: **'24 Blue', another operational Tu-16K-10. Unlike the other versions, production Kazan'-built Tu-16K-10s never carried the c/n visibly.** Yefim Gordon archive

Above right: **Lower view of a K-10S under the belly of a Tu-16K-10.** Yefim Gordon archive

Left: **'75 Red', a production Tu-16K-10, taxies at a snowbound airfield on a winter afternoon.** Yefim Gordon archive

Bottom: **Head-on view of a Tu-16K-10.** Tupolev JSC

Opposite page:

Top: **Maintenance day in a Soviet Navy unit as a Tu-16K-10 is jacked up for a wheel change and possibly landing gear operation checks. The dispersal area has a central taxiway and a guard tower.** Yefim Gordon archive

Bottom left: **'16 Red' (c/n 1884001), a Kuibyshev-built Tu-16K-10(ZA), passes overhead, showing the semi-recessed missile.** Yefim Gordon archive

Bottom right: **An atmospheric shot of Tu-16K-10 being prepared for a sortie.** Yefim Gordon archive

Nikita S Khrushchov's preoccupation with replacing strategic bombers by ICBMs raised questions about the viability of persevering with the K-10 system, and the Kuibyshev factory was instructed to terminate Tu-16 production in favour of manufacturing the R-7 ICBM. Only a joint letter to the Communist Party's Central Committee sent by the Deputy Chairmen of the Council of Ministers, Dmitriy F Ustinov and Boris M Ryabikov, GKAT Chairman Pyotr V Dement'yev and Soviet Air Force Commander-in-Chief Air Marshal K A Vershinin, pointing out the inadequacy of the USSR's air-to-surface missile carrier resources (a mere 90 Tu-16KSs) and the comparative shortcomings of their weaponry averted this. The instruction was revoked and an order for another 173 Tu-16s placed. Thanks to this, plant No 1 in Kuibyshev had provided the Naval Air Arm with 59 Tu-16K-10s by July 1960 when it was ultimately reassigned to building rockets and missiles.

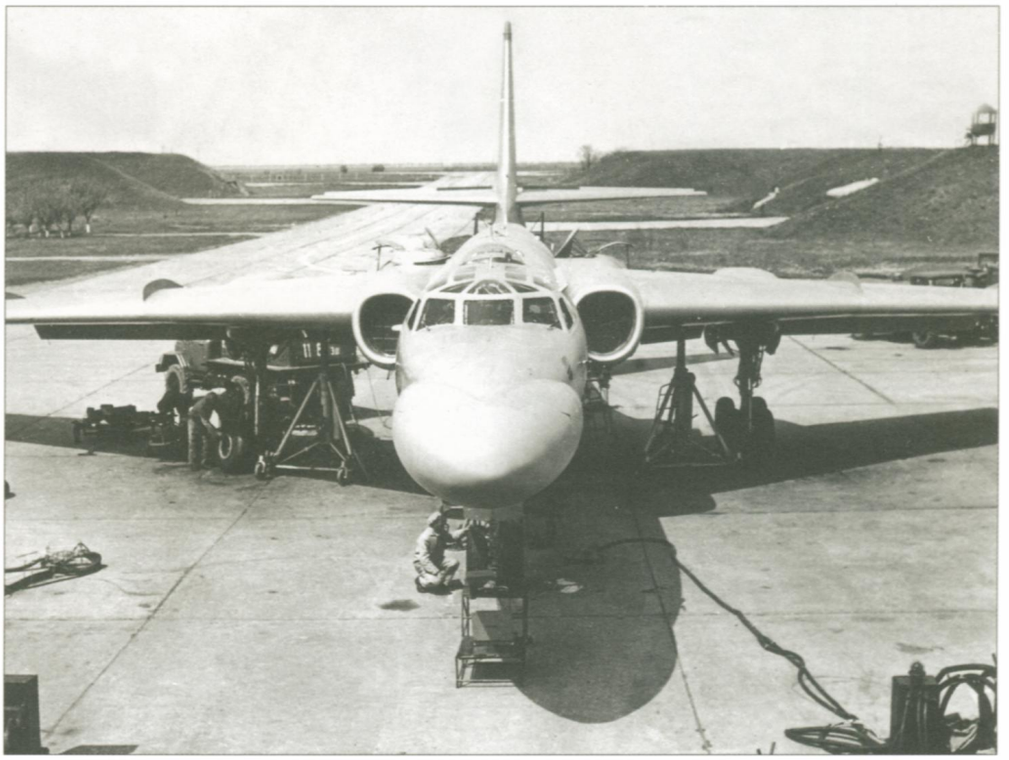
In June 1961 series production of the Tu-16K-10 was reinstated at plant No 22. Including the first seven examples, the Kazan' factory had supplied 157 Tu-16K-10s by the end of 1963 when the type was finally phased out of production. In all, 210 examples of the Tu-16K-10 were built.

Dry launches of the K-10 were practised, using ships of the Black Sea Fleet as targets, and live launches carried out against decommissioned vessels between September 1959 and November 1960. The old tanker M/V *Chkalov* specially fitted with a tall wire mesh contraption by way of a superstructure to increase the radar signature was used to simulate a cruiser-sized target; if a missile hit the wire mesh, this was considered a 'kill'. In the course of the joint State trials, Tu-16K-10 missile-carriers made 184 flights. Problems encountered during the trials delayed their official completion until the second quarter of 1960, although in reality they were not completed until the end of the year. Only four launches were made in 1960.

The trials program involved both Tu-16K-10 prototypes, the two MiG-19SMK 'missile simulator' testbeds and 34 K-10S missiles, three of which had live warheads. Out of the 20 launched, only 10 hit their targets. Failures were due to crew errors (one missile destroyed an ice floe instead of the target vessel), failures of the radars and one failure of the missile's engine. According to the system's designers there was a 71.4% chance of the K-10S hitting its target; in the opinion of the Naval Air Arm it was only 62.4%. Another unpleasant fact emerged during the trials; the location of the weapons systems operator's pressurised cabin in the forward part of the equipment bay where the air temperature was somewhat higher than elsewhere in the aircraft meant that he was subjected to temperatures over 40°C in the summer.

There were, however, positive aspects to the trials. Large ships could be detected at distances close to the theoretical radar horizon and a lock-on was achieved after closing by a further 50 or 60km. Although special maximum-range tests on the missile had not been performed, after one miss a K-10S had carried on to cover 245km in ten minutes and ten seconds and splashed down with some fuel still left. In 1959 the K-10 achieved initial operational capability with the Soviet Navy as the first highly effective supersonic air-to-surface missile system.

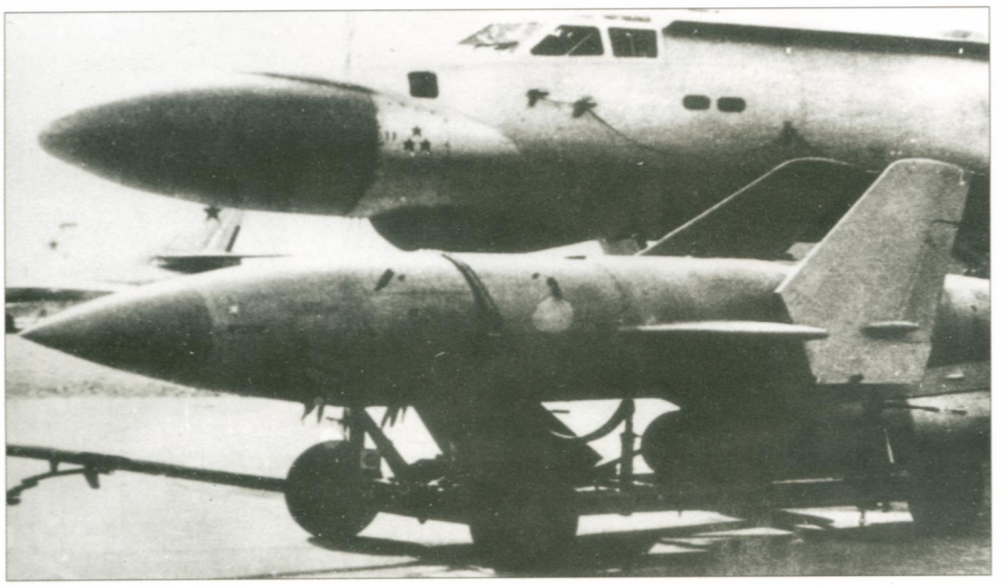
The K-10 had a maximum combat radius of 2,400km; the carrier aircraft's cruising speed was 700-800km/h, and a target (a cruiser-sized vessel) could be detected at 240-360km. The K-10S missile was launched at 170-200km from the target at altitudes between 5,000-11,000m, the aircraft approaching within 110-150km of the target by the time the missile switched to active homing mode and flew on with an 80% 'kill' probability. The K-10S weighed 4,418-4,550kg with a normal warhead weighing 835kg. Its maximum speed was 1,700-2,000km/h.



Top: **'15 Red', another Kuibyshev-built Tu-16K-10(ZA).** Yefim Gordon archive

Above: **Kazan'-built Tu-16K-10 '12 Blue' was one of several fitted with an SPS-100 Rezeda jammer in a UKhO tail fairing.** Yefim Gordon archive

Below: **The wings of the K-10S folded upwards to save space on the ground. Note that the Tu-16K-10 in the background sports three 'kill' stars signifying successful missile launches.** Yefim Gordon archive



The basic performance of the Tu-16K-10 is indicated in the following table:

Length overall	36.2m
Fuselage length	35.7m
Height on ground	9.95m
Wing span	32.989m
Wing area	164.65m²
Empty weight	39,600kg
Empty weight with residual fuel	40,380kg
Take-off weight	
normal	75,800kg
maximum (exceptional conditions)	79,000kg
Fuel load	39,700kg
Fuel capacity	32,150 litres
Weapons load (one K-10S ASM)	4,400kg
Max speed at full power*	
up to 500m	670km/h
at 6,250m	890km/h
at 10,000m	930km/h
Service ceiling:	
at nominal power with an ASM †	12,300m
with no ASM †	12,800m
Climb time to 10,000m †	15 mins
Climb time to service ceiling	33 mins
Range ‡	4,850km
Take-off run	
with a 75,800-kg take-off weight	1,900m
with a 79,000-kg take-off weight	2,200m
Landing run, brake parachute deployed	
with a 48,000-kg landing weight	1,100m
with a 57,000-kg landing weight	1,300m
Landing run, brake parachute not used	
with a 48,000-kg landing weight	1,300m
with a 57,000-kg landing weight	1,750m
Required runway length	2,500m

* with an ASM and a 60,000-kg all-up weight
† with a 62,000-kg all-up weight
‡ on a 'hi-hi-hi' mission with a 75,800-kg take-off weight, with 5% fuel reserves and mid-flight missile launch

On 12th August 1961 the Council of Ministers issued directive No 742-315 clearing the K-10 weapons system for Soviet Navy service. In the summer of that year production examples of the Tu-16K-10 were shown over Moscow-Tushino airfield during the annual Aviation Day flypast; this was the first time they had been shown to foreign air attachés. The K-10S ASM was given the NATO codename *Kipper* and the Tu-16K-10 the codename *Badger-C*.

In 1962 the possibility of operating the Tu-16K-10 from unpaved airfields was explored, but it was not pursued in practice. On 22nd August 1962 a K-10S air-to-surface missile with a 6-kiloton nuclear warhead was launched over the test range at the Novaya Zemlya ('New Land') archipelago by a North Fleet Air Arm Tu-16K-10 during the *Shkval* (Squall) exercise. The huge responsibility associated with this important mission weighed so heavily on the WSO that he messed up the pre-launch procedure, managing to complete it correctly only on the second try.

Some Tu-16K-10s were equipped with an SPS-151, SPS-152 or SPS-153 Siren' jammer

A steady stream of Tu-16K-10s passes overhead during the 1961 Aviation Day parade. Yefim Gordon archive

This *Badger-C* coded '15 Red' is the Tu-16K-10-26 prototype carrying one K-10S missile and two KSR-5 missiles. Yefim Gordon archive

in a UKhO tail fairing. Others featured an SPS-100 Azaliya jammer in a UKhO fairing complemented by an SPS-5 in the avionics bay. Some examples were retrofitted with ASO-2A-E7R IRCM flare dispensers.

Tu-16K-10ZA
('order 238', *izdeliye* NK-10ZA and NK-1)
As already noted, this was a version of the Tu-16K-10 equipped for wingtip-to-wingtip IFR. Only five aircraft were completed in this configuration in Kazan'; later, however, all Kuibyshev-built Tu-16K-10s had IFR capability.

Tu-16K Development Aircraft
Between 1959 and 1961 GK NII VVS tested three examples of the Tu-16K – a version of the Tu-16K-10 re-engined with RKBM (Zoobets) RD16-15 turbojets. Apart from structural modifications, the electric starters of the new engines required additional DC batteries to be provided.

The Tu-16K was intended for use by the Naval Air Arm and differed little from the Tu-16K-10, apart from its longer range thanks to the more fuel-efficient new engines. At the same time GVF tested two prototypes of the Tu-104E – a derivative of the Tu-104B fitted with the same engines. Although the tests of the Tu-16K were successful it was not placed in production.

Tu-16K-10D
(izdeliye NK-10D, *izdeliye* NK-1D)
One of the items of the said CofM directive No 742-315 of 12th August 1961 clearing the Tu-16K-10 for service ordered the K-10 system as a whole to be updated; within three months the organisations involved were to suggest ways of extending the K-10 missile's range to 300-350km. Studies carried out by the Naval Air Arm's 33rd Combat & Conversion Training Centre at Kool'bakino AB in Nikolayev indicated the possibility of launching the K-10S from an altitude of 600m over a range of up to 325km. Work on an improved system known as the K-10M began in 1961, but was complicated by the simultaneous requirements to increase its range and decrease the altitude at which it was launched. The resulting missile was the K-10SD with a greater fuel load, while its Tu-16K-10D carrier was to have a modernised YeN-D radar with a detection range of 400-450km (in both cases, D stands for ***dahl'***n-***odey***stvuyushchaya – long-range).

The K-10D complex with its longer-range K-10SD missile had obvious advantages when compared to the K-10, but by the end of the 1960s the Western navies' shipborne anti-aircraft defences had greatly improved. Aircraft carrier groups had little difficulty in detecting a large subsonic enemy aircraft flying at cruising altitude 500km away. It was therefore decided to extend the range of altitudes at which the K-10SD could be launched by modifying the airborne and missile radars. The resulting K-10SDV (*vy**sot**naya* – high-altitude) could be launched at any altitude between 1,500 and 11,000m, increasing the missile's effectiveness and making the aircraft less vulnerable. In early 1970 tests of the system against a target from medium altitude confirmed its value and viability, after which some of the Tu-16K-10Ds were again modified by Naval Air Arm maintenance bases. These machines could carry K-10SD and K-10SDV missiles (launched from 1,500m), as well as the older K-10S and the low-altitude K-10N and K-10SNB, although in these cases the attack range was curtailed. The K-10SDV/SN/SNB could be launched from 1,500m and the K-10S/SD from between 5,000 and 11,000m.

Head-on view of the Tu-16K-10-26 prototype with a full weapons load. Tupolev JSC

Tu-16K-10-26 '41 Red' cruises over hilly terrain (presumably in the Soviet Far East), carrying a full complement of three missiles. Traces of the (unfortunately incomplete) c/n ...651034 (the first digit is in all probability 4) are discernible on the fin. Yefim Gordon archive

Tu-16K-10N
(*izdeliye* NK-10N, *izdeliye* NK-1N)

The increased potency of shipborne anti-aircraft defences prompted another development of the K-10 to enable it to be launched at low level. Estimates suggested that decreasing the height at which the missile was launched would halve its vulnerability to anti-aircraft fire and fighter interdiction. The K-10SN and K-10SNB (the latter with a nuclear warhead) were carried by the Tu-16K-10N (*izdeliye* NK-10N) equipped with a modified YeN-2-6 radar and could be launched from an altitude of 500-600m; the N suffix stood for ***niz****kovy****sot****naya* – low-altitude. During the terminal guidance phase the missile flew only a few metres above the water. The range at which a 'cruiser-type' target could be attacked by the K-10SNB was in the order of 350 to 420km. The Tu-16K-10N could carry a standard K-10S, but had to launch it at altitudes between 5,000 and 11,000m. The K-10SN and K-10SNB could also be used by the Tu-16K-10 or Tu-16K-10D, but in these instances the missiles could only be launched at the aircraft's normal operating altitudes.

Tu-16K-10P

Between 1972 and 1979, development work was carried out on fitting an Azaliya active jammer to a K-10SN missile in lieu of a warhead. Designated K-10SP (for *po****mekh****i* – interference or jamming), this 'ECM missile' was to be used to cover the launch of ordinary live missiles and carried by an aircraft designated Tu-16K-10P. The complex was designated the K-10P.

The Tu-16K-10ZA, Tu-16K-10D, Tu-16K-10N and Tu-16K-10P shared the common NATO codename *Badger-C*.

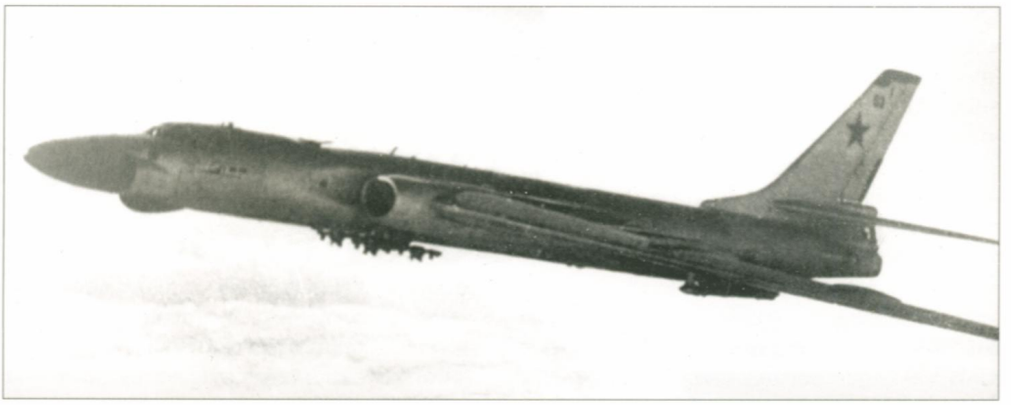
Tu-16K-10-26
('order 644', *izdeliye* NK-10-26 and NK-6)

The K-26 anti-radar weapons system was incorporated not only on Tu-16 ASM versions used against ground targets but on anti-shipping versions as well. The modified system developed in accordance with CofM directive No 552-229 of 23rd June 1964 was given the designation K-10-26 (at the design stage it was provisionally known as the K-36 – that is, 'K-10' + 'K-26' = 'K-36', but this designation was short-lived). It was intended for use against radar-defined land and sea targets, using KSR-5, K-10SD or K-10S missiles (the latter two were for use solely against shipping).

The Tu-16K-10-26 (Tu-16K-36) carried two KSR-5s or KSR-2s on the wing hardpoints (using a VN guidance system, also called *Ve****nets*** – Crown) or a single K-10SD or K-10S on the centreline (working with the YeN-D radar). The two Tu-16K-10-26 prototypes were converted by the Kazan' aircraft factory No 22 from standard Tu-16K-10Ds (c/ns 1793014 and 2743054; the former aircraft was coded '15 Red'). Ground checks and manufacturer's flight tests were held between November 1966 and March 1967 in Kazan'. Joint State trials began in April 1967; however, due to modifications to the broadly similar K-26 system, they did not commence in earnest until May 1968.

On 12th November 1969 the K-10-26 system was cleared for service with the Naval Air Arm by Council of Ministers directive No 882-315, with the ensuing conversion of 85 Tu-16K-10D to Tu-16K-10-26 standard. The modifications,

This aircraft coded '63 Red' represents the Tu-16K-10-26B version featuring conventional bomber capability; note the MBDU-46-68N MERs under the fuselage. Yefim Gordon archive



These Tu-16K-10-26Bs are equipped with single BD4-16-52 bomb racks under the fuselage. Yefim Gordon archive

including wing reinforcement, revisions to the flap controls and fuel system, were carried out under the terms of 'order 644' at Naval Air Arm maintenance factories in the 1970s. Some of the 85 examples carried Siren' jammers in UKhO tail fairings while others retained the tail gunner's position. Externally the Tu-16K-10-26 was distinguishable from other versions of the Tu-16K-10 by the underwing missile pylons.

The performance was almost identical to that of late-production Tu-16K-10s, with the following exceptions:

Weight empty with residual fuel	41,850kg
Weapon load	
one K-10S	4,400kg
two KSR-5	7,600kg
one KSR-5	3,800kg
two KSR-5 and one K-10S	12,000kg
one KSR-5 and one K-10S	8,200kg
Service range*	4,700km

* at optimum altitude with a K-10S and a 75,800-kg take-off weight, with 5% fuel reserves and mid-flight missile launch

Tu-16K-10-26N (*izdeliye* NK-10-26N, *izdeliye* NK-6N)

The Tu-16K-10N modified to take the K-26 weapons system was given the new designation Tu-16K-10-26N (or *izdeliye* NK-10-26N). The simultaneous use of two high-speed, high-altitude KSR-5 missiles with a low-altitude missile of the K-10S type put the enemy anti-aircraft defences in a much tougher situation.

Tu-16K-10-26P ('order 2303', 'order 644P', *izdeliye* NK-10-26P, *izdeliye* NK-26P)

In keeping with ruling No 14 passed by the Council of Ministers' Military Industrial Commission (a standing committee on defence matters) on 21st January 1976 and pursuant to MAP order No 56 of 9th February 1976, in the late 1970s a small number of Tu-16K-10-26s with ECM tail fairings were modified to carry KSR-5P missiles and equipped with the ANP-K system for locating active enemy radars. Designated Tu-16K-26P, the aircraft could carry KSR-5s with active radar homing or KSR-5P ARMs, as well as normal attack missiles (one K-10S and two KSR-5s or KSR-2s of various versions). The revised complex was given the designation K-10-26P. The Tu-16K-10-26 and Tu-16K-10-26P shared the NATO codename *Badger-C Mod*.

Tu-16K-10-26B ('order 2644B', *izdeliye* NK-10-26B, *izdeliye* NK-6B)

The issue of enhancing the tactical and strategic potential of the Tu-16K-10 by reactivating its bomber, mine-laying and torpedo-bomber capabilities was raised several times by the Soviet Air Force, culminating in CofM directive No 709-337 of 2nd July 1958 ordering the Tupolev OKB to explore the possibility of using the *Badger-C* for delivering conventional and nuclear free-fall bombs by 1st August. Accordingly in the 1970s the Tu-16K-10-26 underwent such a modification at Naval Air Arm maintenance factories to enable it to carry a 4,000-kg bomb or mine load or four 650-kg torpedoes under its wings (using multiple-store racks under the fuselage and racks attached to the standard missile pylons) and a further 4,000kg of bombs or mines or four more torpedoes internally. Designated Tu-16K-10-26B, it possessed both air-to-surface missile and conventional bomber capabilities. Examples of the Tu-16K-10-26B modified to carry bombs or torpedoes in this way were referred to as *izdeliye* NK-10-26B or NK-6B in service.

Reconnaissance and Electronic Countermeasures Versions

Tu-16R & Tu-16RN (aircraft '92' project)
OKB-156 began work on a reconnaissance aircraft based on the Tu-16 bomber in 1953. From the outset, the resulting aircraft was conceived as combining photographic reconnaissance, electronic intelligence (ELINT) gathering and the resources to jam enemy air defence radars. Much depended on the design and production of the crucial electronic equipment.

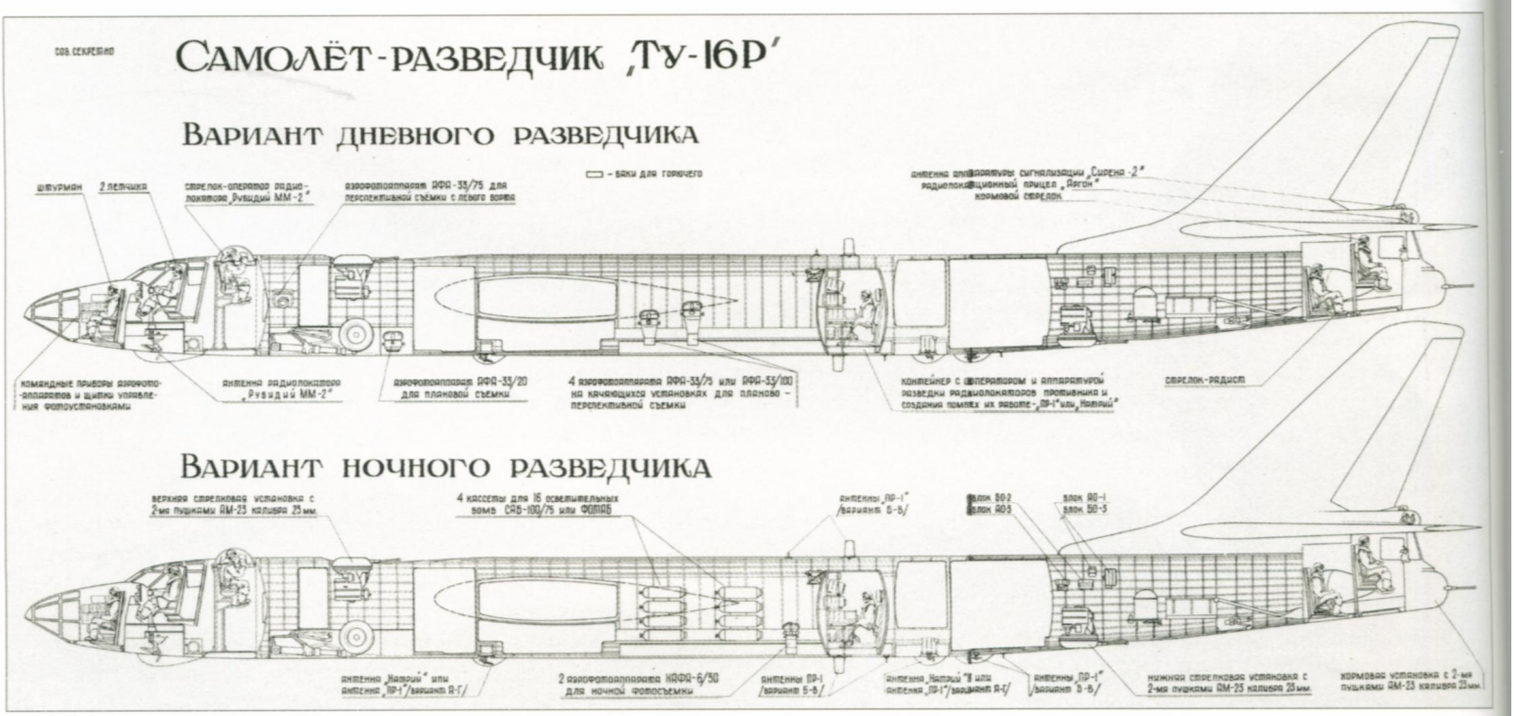
The Council of Ministers directive No 1659-657 of 3rd July 1953 and the corresponding Ministry of Defence Industry order No 521 of 18th July called for the creation of the following:

- a new RBP-6 ***Lyu**stra* (Chandelier) bomb-aiming radar developed from the production Rubidiy-MM-2 (Rubidium), able to overcome enemy ECM by means of an ECM-resistant high-frequency head, a 2-cm waveband antenna/feeder array and an antenna with a wider scanning arc. Two sets of the new equipment were to be provided by TsNII-108 and OKB-253 by 1954, while OKB-156 was to carry out the installation of one set on a production Tu-16 in the autumn of that year.
- a new *Sili**kaht*** (Silicate) active jammer with a 21.8-30.5cm waveband for jamming enemy ground and shipborne air defence and fighter control radars. This was to be supplied by TsNII-108 which was to co-operate with OKB-156 in installing the set in a Tu-16 in the late spring and early summer of 1955.
- a new *Apa**tit*** (Apatite) active jammer with a 2-10cm waveband for jamming enemy ground and shipborne detection, guidance and target marking radars. This was again the responsibility of TsNII-106 which was to co-operate with OKB-156 in installing this on a Tu-16 during the autumn of 1954.
- a new *Avto**maht***-2 (Automatic device) airborne automatic chaff dispenser to scatter radar-reflecting strips of metal-coated glassfibre (chaff) at three- to five-second intervals, working in the 0.6-12cm waveband. The equipment was to be designed by I I Toropov's OKB-134 and ready for state trials on a Tu-16 in the late summer and autumn of 1954.
- a new SRS-3 Romb-1 (Rhombus) automatic ELINT set (SRS = ***stanh**tsiya raz**ved**ki **svya**zi* – communications intelligence set) for use against enemy ground, shipborne and aircraft radars which registered the working frequencies of the radars it detected over the bandwidth 2.9 to 30cm. This was to be supplied by OKB-483 and TsNII-108 and installed on a Tu-16 with the co-operation of OKB-156.
- a new electronic counter-countermeasures (ECCM) high-frequency head and array developed under the *Pla**neta*** programme to protect the *Izum**rood*** (Emerald) airborne intercept radar (developed for the MiG-17P interceptor) and Argon gun-laying radar with a 3-cm waveband from unsynchronised pulse interference. The Ministry of Electronics' NII-17 under Vladimir V Tikhomirov was to join forces with OKB-156 in installing this ECCM kit on a Tu-16 in the spring of 1954.

In addition to these projects, work was begun on other equipment more resistant to electronic interference: the Rubin bomb-aiming radar (OKB-283, NII-17, TsKB-589), the Topaz (NII-17) and Xenon (OKB-373) radars and the Khrom-Nikel' (Chrome-Nickel) IFF interrogator/transponder. Experimental models of the PR-1 combined ELINT/ECM equipment and the Natriy (Sodium) ECM set passed their tests and design work on the ASO-16 (*avto**maht** **sbros**a otra**zha**teley* – automatic chaff dispenser), aka Avtomat-1, for the Tu-4, IL-28 and Tu-16 was completed by I I Toropov's OKB-134.

The camera fit for the reconnaissance version was based on the standard AFA-33 day cameras and NAFA-6 night cameras, with the future intention of using new high-altitude cameras of the AFA-40 type.

This cutaway drawing depicts two configurations of the Tu-16R PHOTINT aircraft for day (above) and night photography. Note the flare bomb cassettes of the latter configuration.
Tupolev JSC



The design and development of this new equipment involved the close co-operation of the aircraft designers, who had to work out the best and most compact ways of installing it. On 24th June 1953 MAP issued order No 405, followed by Air Force Operational Requirement No 1197989 which was received by OKB-156 on 9th July; these documents required the OKB to fit the PR-1 and Natriy to production Tu-16 aircraft. After making some preliminary assessments the Tupolev OKB judged it more expedient to develop a dedicated reconnaissance version, the Tu-16R ([*samo**lyot***-] *raz**ved**chik* – recce aircraft) equipped for photographic and electronic intelligence. This was accepted by the Air Force, and on 23rd June 1954 the Council of Ministers issued directive No 1249-558 followed by MAP order No 408 of 29th June. These documents tasked Tupolev with building the Tu-16R powered by two modernised AM-3M-200 engines (rated at 9,500kg for take-off and 7,650kg at nominal power) giving a range of 6,000-6,200km. The Air Force was to place one of its Tu-16s at the disposal of the OKB in July 1954 and supply the necessary radio and photographic equipment. The Tu-16R was to be ready for State acceptance trials in March 1955.

The advanced development project of the Tu-16R or 'aircraft 92' approved in November envisaged two versions: a daylight reconnaissance version (Tu-16R) and a nocturnal reconnaissance version (Tu-16RN, *raz**ved**chik noch**noy***). As most early Soviet ELINT and ECM systems were not automated, the Tu-16R had to have a special pressurised crew compartment (similar to that on the Tu-16KS) for their operator, bringing the number of crewmembers to seven. The operator was to be given an ejector seat, but shared his quarters with some of the PR-1 (or 'Natriy') equipment and an air conditioning system. The antennas for the PR-1 (or 'Natriy') were housed in fairings above and below the operator's position as well as in dielectric blisters under the fuselage and wing centre section. It was also intended to accommodate the SPS-3 Romb-1 ELINT equipment in underwing pylon-mounted pods. In the aircraft's tail section an antenna for the Sirena-2 radar warning receiver (RWR) was to be fitted above the radome of the Argon gun-laying radar. The standard Rubidiy-MM-2 radar was fitted with a special FA-PL-1 camera for photographing images on the radar screen. Upon inclusion into the inventory the PR-1 jammer was designated SPS-1, SPS-2 and SPS-2K.

The Tu-16R day reconnaissance version was to be equipped with four AFA-33/75 or AFA-33/100 cameras on AKAFU pivoting mounts for daylight vertical photography in its camera bay. An AFA-33/20 vertical camera was also carried for 'opportunity en route' photography. Behind the forward pressurised cabin an AFA-33/75 for oblique photography was provided with a rectangular camera window on the port side. The night reconnaissance version was to carry two NAFA-6/50 night cameras and 16 flare bombs. Both versions had provision for installing the ASO-16 chaff dispenser in place of the PR-1, an estimated service ceiling (with an all-up weight of 55,000kg) of 12,800m and a range of 6,000-6,200km. At 37,765kg, the empty weight of the Tu-16R would have been 259kg greater than the Tu-16RN's.

Tu-16R-1 Reconnaissance Prototype

Conversion was carried out on a production Tu-16 bomber (c/n 1880302) built at the Kuibyshev aircraft factory No 1 in December 1954. Re-designated the Tu-16R-1 after modification at plant No 22, with the assistance of the Kazan' branch of OKB-156, the first prototype carried a single AFA-33/20M vertical camera, two AFA-33/75M for oblique photography and two AFA-33/10M for 'opportunity en route' photography. An SPS-1 active jammer was also provided. The crew consisted of seven members, with the radar operator housed in a special pressurised position at the rear of the equipment bay (the former bomb bay, that is).

Manufacturer's flight tests began on 30th November 1955 and were completed by mid-May 1955. Sixteen flights were made totalling 26 hours 16 minutes. The flight test results yielded the following data:

Empty weight	38,436kg
Maximum take-off weight	75,370kg
Maximum speed with TOW of 62,000kg at an altitude of 6,200m	1,000-1,100km/h
Service ceiling	12,400m
Time to an altitude of 10,000m:	
with an all-up weight of 62,000kg	15.1 mins
with an all-up weight of 75,400kg	24.5 mins
Operational range	6,300km
Take-off run	2,290-3,275m

Equipment changes were made in the course of the tests. SRS-3 (Romb-1) ELINT equipment was mounted in pods on pylons beneath the wings and an SPS-1AG set for detailed ELINT work installed in the fuselage. Delays in the flight tests and the late delivery of electronic equipment caused the State trials to be postponed in accordance with CofM directive No 424-261 of 26th March 1956 and MAP order No 194 of 6th April; they took place between 19th June and 17th August 1956, involving 27 flights with 97 hours' total time.

The Tu-16R-1 became the prototype for the production Tu-16R. The production aircraft was to have SRS-1AG and SRS-3 ELINT and SPS-1 and SPS-3 ECM equipment. In contrast, the prototype had only the SRS-1AG and four AFA-33/75M and AFA-33/100M cameras for two-/four-strip photography, for which special apertures (with protective shutters) were cut in the equipment bay doors. The prototype also had provision for twin NAFA-6/50 cameras for night photography at the rear part of the equipment bay and an aperture on the port side of the fuselage for an AFA-33M/75 oblique camera. Although underwing pylons were fitted for the SRS-3 pods, the pods were not fitted as there were problems with the SRS-3 which prevented its submission for State trials. The Tu-16R-1 was also tested with various combination loads of flare bombs for night photography. When the cameras were removed from the equipment bay, the machine could be reconverted to bomber configuration.

The positive results of the State trials were followed by an order for series production in December 1956 (Council of Ministers directive No 1545-777 of 3rd December and MAP order No 601 of 10th December). The series production model was to be powered by two AM-3M engines, and 44 examples were built in 1957 at plant No 1 in Kuibyshev after the defects and shortcomings noted during the prototype trials had been rectified. The Tu-16R-1 was to become the basis for a series of reconnaissance and ECM versions of the Tu-16, including the Tu-16SPS, Tu-16P, Tu-16 Yolka and so on.

Tu-16 Romb Reconnaissance Aircraft ('order 261')

Although the SRS-3 Romb-1 was not available in time for the manufacturer's tests or State trials, it was still planned to fit it to the Tu-16R-1 once it became available. But tests with the intended underwing pods showed that increased drag caused some deterioration in the aircraft's performance. It was therefore decided to accommodate the SRS-3 in the fuselage, the antenna being housed in a dorsal fairing. The urgent need for this long-range reconnaissance aircraft led to plant No 1 at Kuibyshev producing the first five aircraft equipped with the SRS-3 (designated Tu-16 Romb) in 1956. In production they were referred to as 'order 261', and they are sometimes called Tu-16R 'Romb' or simply Tu-16R. There was, however, little reduction in drag and subsequent production examples had the SRS-3 equipment housed in underwing pylon-mounted pods as originally planned.

Later, all five of these aircraft were retrofitted with the SRS-1 ELINT system.

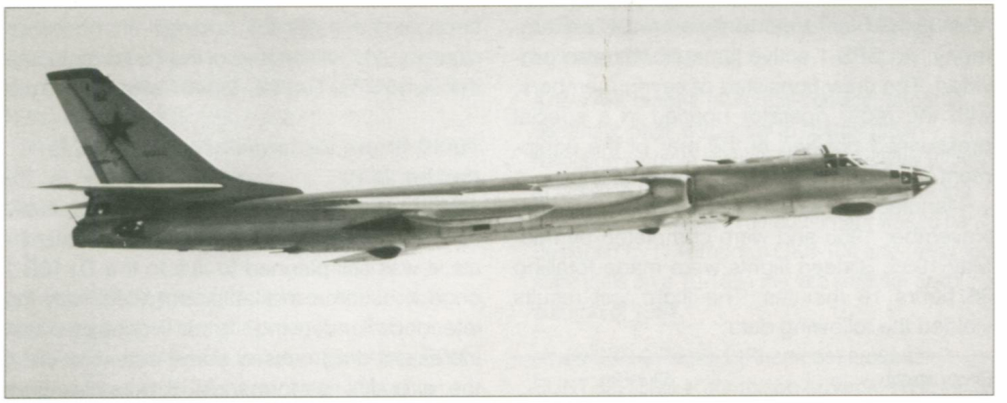
Tu-16R Reconnaissance Aircraft ('order 361', *izdeliye* NR)

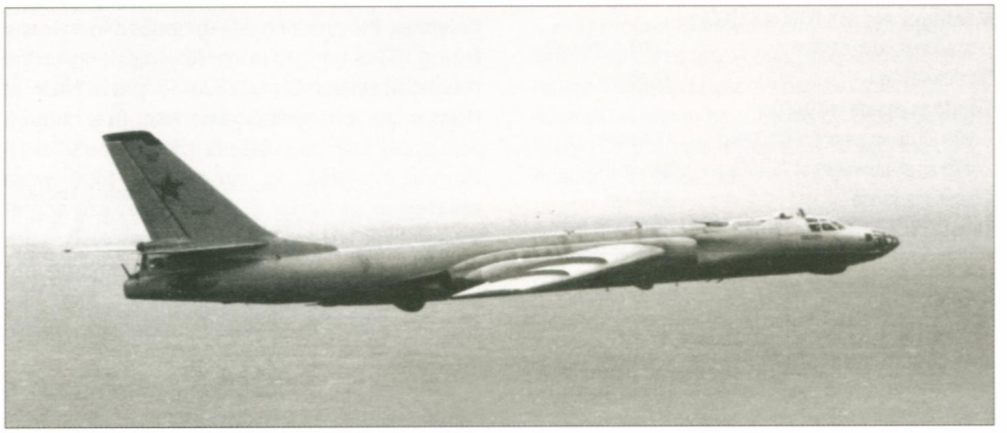
In 1957 plant No 1 produced 44 Tu-16Rs and a further 26 in 1958 with various reconnaissance equipment fits in accordance with the above-mentioned directive No 1545-777. Of the total of 70 Tu-16R reconnaissance aircraft built on the model of the Tu-16R-1 prototype (with pylon-mounted underwing pods for the SRS-3), plant No 1 supplied the following variants:

- 18 aircraft with SRS-1 (bands A, B & C) and SRS-6
- 18 aircraft with SRS-1 (bands D & E) and SRS-3
- 34 aircraft with the SRS-1 (bands D & E)

(Note: These are purely conventional designations for wavebands whose frequencies are not known; this should not be confused with the familiar terms such as 'J-band' or 'S-band'.)

Examples with the SRS-3 were given the production designation 'order 361' and were known in service as *izdeliye* NR. The equip-





Left: **Tu-16R '26 Red' (c/n 1882710) represents the original production version equipped with the SRS-1 SIGINT system (identifiable by the ventral dielectric blister ahead of the bomb bay) and the SRS-4 SIGINT system with a similar but slightly larger teardrop fairing aft of the bomb bay.** Yefim Gordon archive

Cente and lower left: **Tu-16R '12 Red' (c/n 1883304) features an SRS-4 SIGINT system identifiable by the slightly larger rear dielectric blister. Note the blade aerial above the flightdeck; the aircraft's communications suite has been updated.**

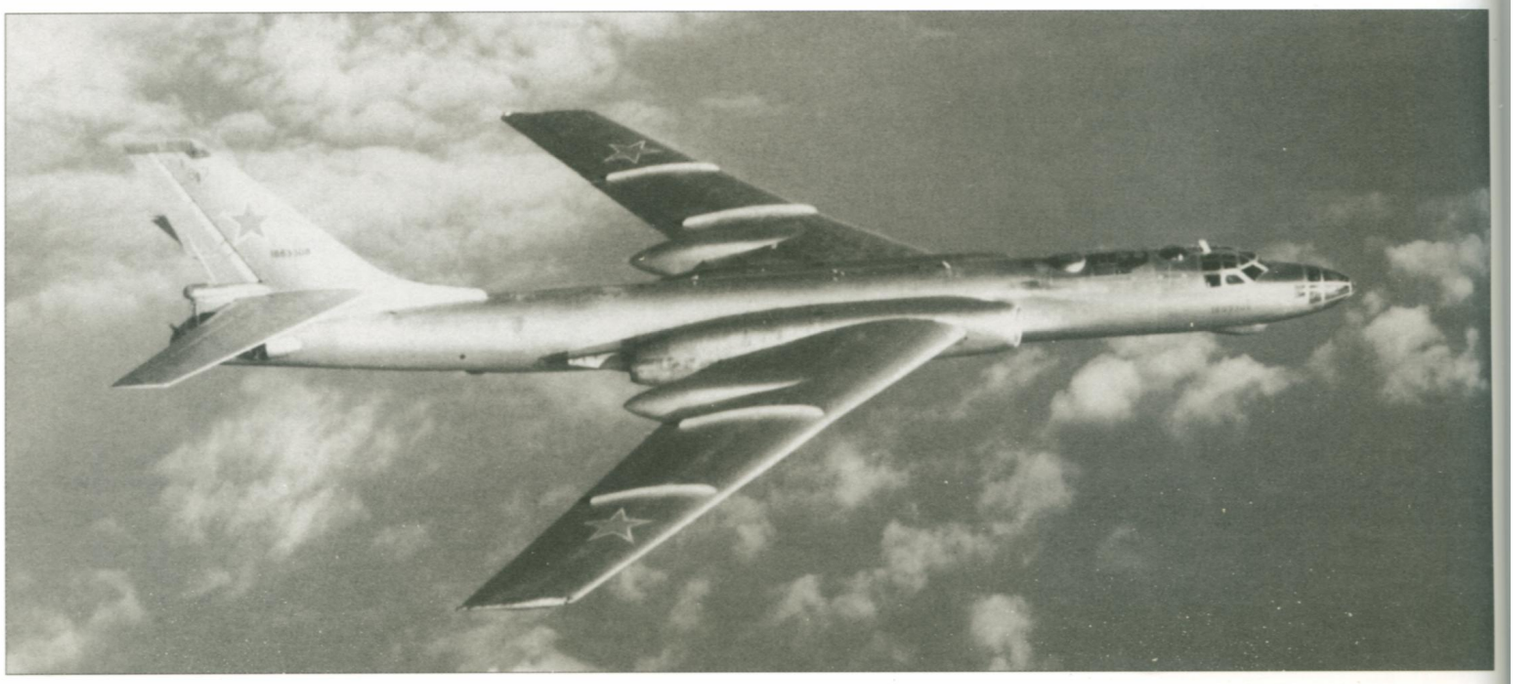
Bottom: **Photographed at high altitude from a shadowing NATO fighter, '87 Red' (c/n 1883308) is an IFR-capable Tu-16R(ZA).** All three *Jane's All the World's Aircraft*

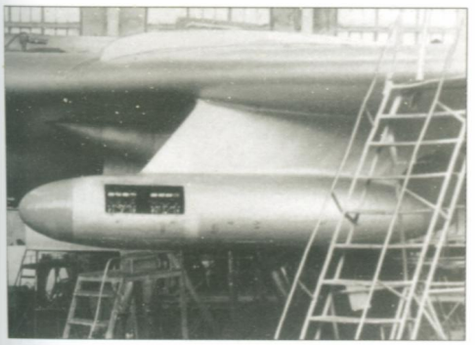
ment bays housed the ASO-16 Avtomat-1 and ASO-2B Avtomat-2 chaff dispensers. In service the Tu-16R could carry one of four sets of cameras, depending on the mission.

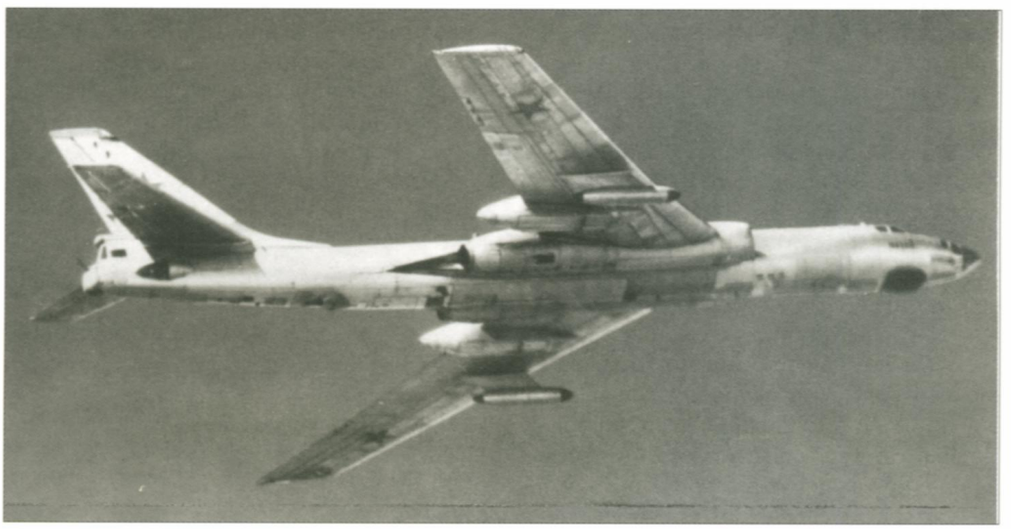
As mentioned earlier, the Tu-16R was produced in two versions (for day and night photography). Over its service life more modern cameras were fitted. During maintenance work some Tu-16R had the more sophisticated SRS-4 *Kvad**raht*** (Square) SIGINT system installed in place of the SRS-1. The teardrop fairing for the SRS-4 was slightly bigger than for the SRS-1. The following figures refer to the Tu-16R without the SRS-3 fitted:

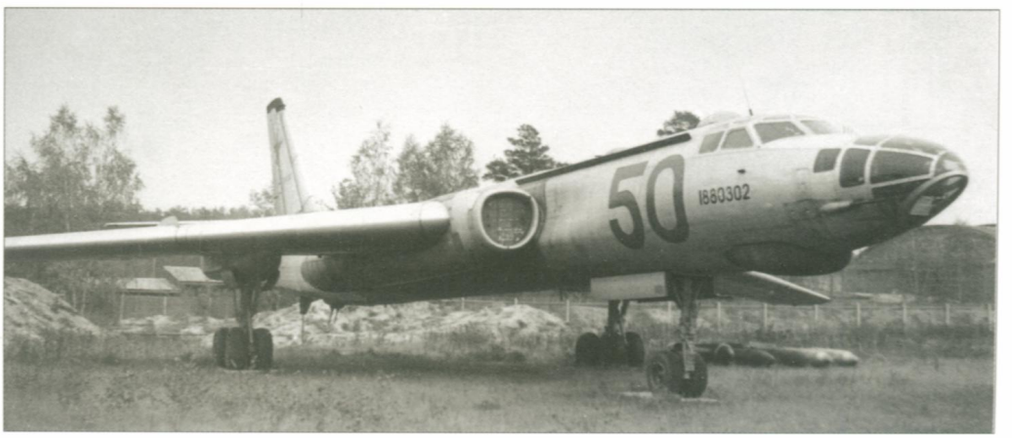
Maximum take-off weight	75,800kg
Maximum speed	
at 250m	1,000km/h
at 10,000m	930km/h
Operational range with 5% fuel reserves	6,300km
Service ceiling	13,100m
Take-off run	1,800m
Length and width of camera coverage	600 x 13km

The Tu-16R 'order 361' (with underwing SRS-3 pods) was given the NATO reporting name *Badger-F* and the Tu-16R without underwing pods was known as the *Badger-E*.









Tu-16R-2 Experimental Reconnaissance Aircraft ('order 455')

On 11th June 1956 the Council of Ministers issued directive No 788-437 followed by MAP order No 343 on 23rd June. They required the Tupolev OKB to equip a Tu-16 with two AFA-40 high-altitude cameras, two AFA-33/20M cameras and an AFA-37 wide-angle camera, submitting it for checkout trials in January 1957.

Conversion work on the original Tu-16R-1 prototype started at plant No 22 in November 1956, but the prototype of the new version designated Tu-16R-2 was not completed until the summer of 1957. Apart from the cameras, it featured SRS-3 ELINT equipment. On 16th August 1957 the Tu-16R-2 was ferried from to the GK NII VVS base at Chkalovskaya AB near Moscow, but problems with the camera system delayed the checkout trials. These eventually took place between 20th August 1958 and 23rd February 1959. Series production, however, was not recommended – again due to problems with the cameras installed; coded '50 Red', the Tu-16R-2 finally ended up as an exhibit at the Soviet (now Russian) Air Force Museum in Monino near Moscow.

Tu-16RP Reconnaissance Aircraft ('order 697')

A few Tu-16Rs fitted with the podded SRS-3 ELINT system had additional ECM gear. These were given the designation Tu-16RP, the P referring to *po**mekh**i* – jamming.

Tu-16RE Reconnaissance Aircraft

Some Tu-16Rs had their SRS-1 ELINT equipment replaced by the SPS-2 ECM set. The rest of the equipment was unchanged, but the aircraft designated Tu-16RE.

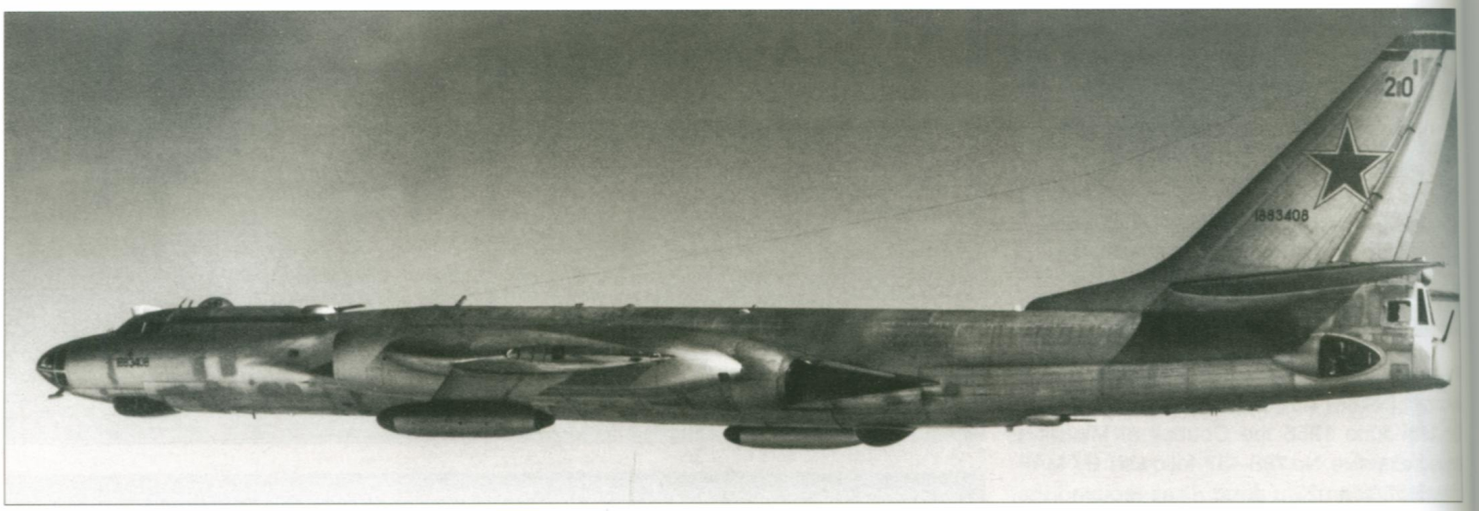
Top left: **The port pod of the SRS-3 Romb-1 SIGINT system under the wing of a Tu-16R undergoing refurbishment in Khabarovsk.** Yuriy Kabernik

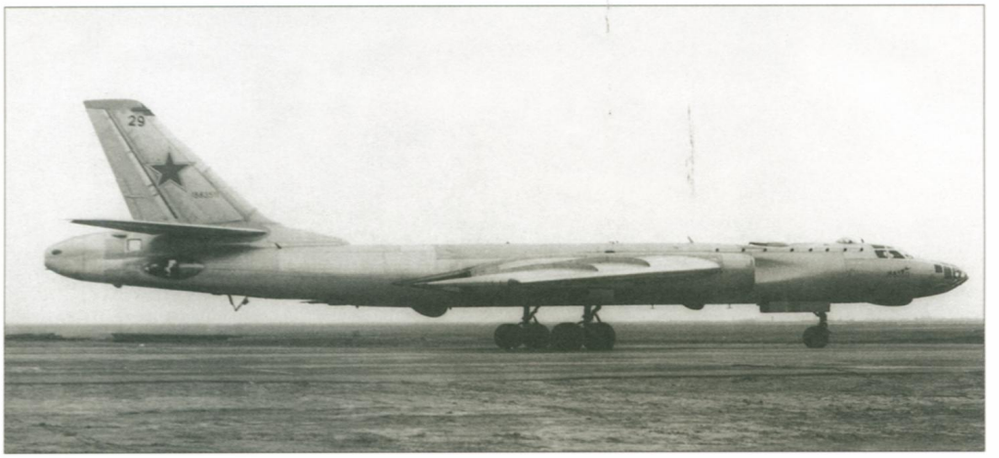
Top right: **A Tu-16R (c/n 1882420) equipped with the SRS-3 system undergoes maintenance.** Yefim Gordon archive

Upper right: **Air-to-air shot of SRS-3 equipped Tu-16R c/n 1883215.** Yefim Gordon archive

Lower right: **Seen just before touchdown, this Tu-16R appears to have differently coloured port and starboard SRS-3 pods.** Yefim Gordon archive

Right: **The Tu-16R-2 on display at the Soviet Air Force Museum in Monino.** Yefim Gordon



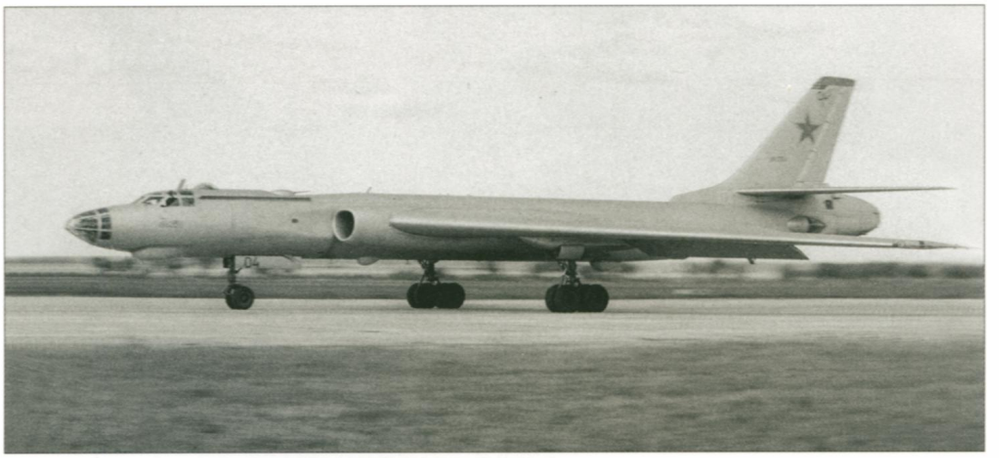


Tu-16R(ZA) '20 Red' (c/n 1883408) combines the ventral blister of the SRS-4 SIGINT system with the SRS-3 Romb-1 SIGINT pods. *Jane's All the World's Aircraft*

Tu-16R '29 Red' (c/n 1883511) equipped with the SRS-1 and SRS-4 was the first reconnaissance-configured Tu-16 to feature an SPS-100M Mal'va jammer in a UKhO fairing replacing the tail turret. Recoded '04 Red', it was later preserved at Dyaghilevo AB, Ryazan'. Tupolev JSC

Tu-16R '04 Red' with an identical SRS-1/SRS-4/ SPS-100M combination. Yefim Gordon archive

Tu-16R '07 Red' (c/n 1883410) with SRS-1/SRS-4 SIGINT gear features a smaller rear ECM fairing housing an SPS-151, SPS-152 or SPS-153 jammer, plus ECM antennas on the extreme nose and under the air intake trunks. Yefim Gordon archive

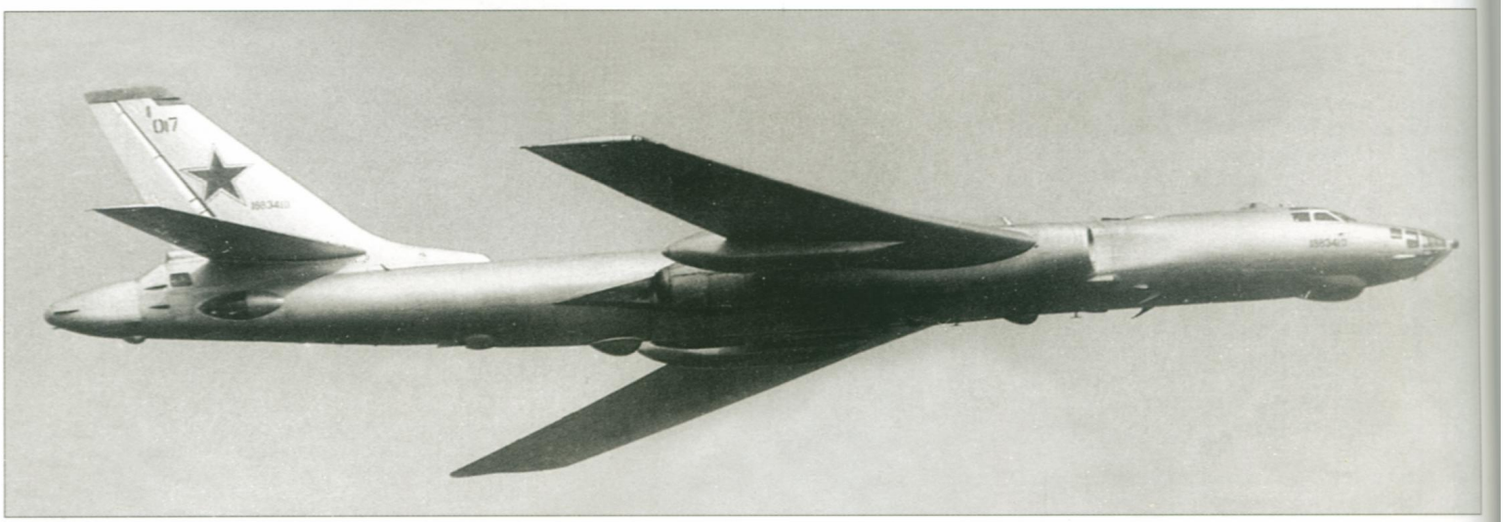


Photographs on the opposite page:

Tu-16R '02 Red' is another dual-mission aircraft combining the ECM suite of the previous aircraft with SRS-3 underwing pods. Yefim Gordon archive

Tu-16RR(ZA) '27 Blue' (c/n 1883305) shows the pylon-mounted RR8311-100 air sampling pods. Yefim Gordon archive

Seen from beneath the wing of Tu-16 c/n 6203004 (a Tu-16A turned missile strike aircraft), Tu-16RR '03 Red' (c/n 1883416) features ECM equipment for self-protection; note the thimble fairing on the nose and the antennas under the air intakes. Yefim Gordon archive



The Tu-16R with the Lyustra Radar Sight

A small number of Tu-16Rs was similarly fitted with the new RBP-6 Lyustra ground-mapping radar. These were given the NATO codename *Badger-K*.

The Tu-16RR NBC Reconnaissance Aircraft ('order 2694')

On 22nd November 1967 the Council of Ministers issued directive No 1081-370 requiring the OKB to create a version of the Tu-16R capable of sampling the atmosphere for nuclear contamination. In October-November 1969 a production Tu-16R (ZA) built at plant No 1 ('27 Blue', c/n 1883305) was accordingly equipped with two RR8311-100 air sampling pods mounted under the wings (replacing the SPS-3 pods), an onboard dosimeter and sampling pod operating controls. Although the new variant was called Tu-16RR (*radiatsi**on**nyy raz**ved**chik* – radiation reconnaissance aircraft), the pods could also be used for detecting chemical and biological contamination. The SRS-1 and camera equipment of the Tu-16R were retained so that the machine could be used as a conventional reconnaissance aircraft. Tests of the filter system were carried out successfully between December 1969 and January 1970.

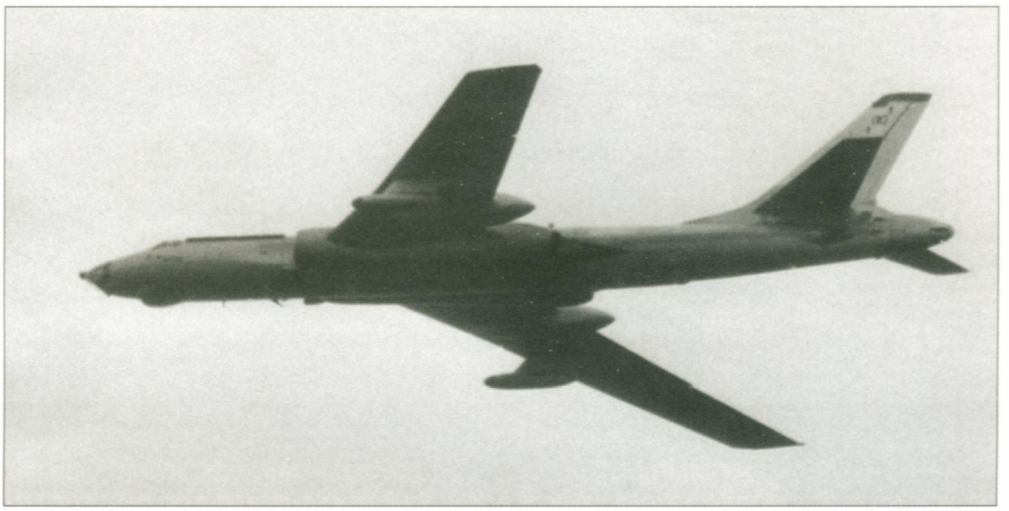
During the early 1970s eight operational Tu-16R (ZA)s were converted to Tu-16RRs, referred to during production as 'order 2694' and by NATO as *Badger-L*. These were used to monitor Chinese nuclear tests; flying at high altitude, they also collected data from Soviet underground nuclear weapons testing programmes. Each of these flights counted as an operational mission for the aircraft's crew.

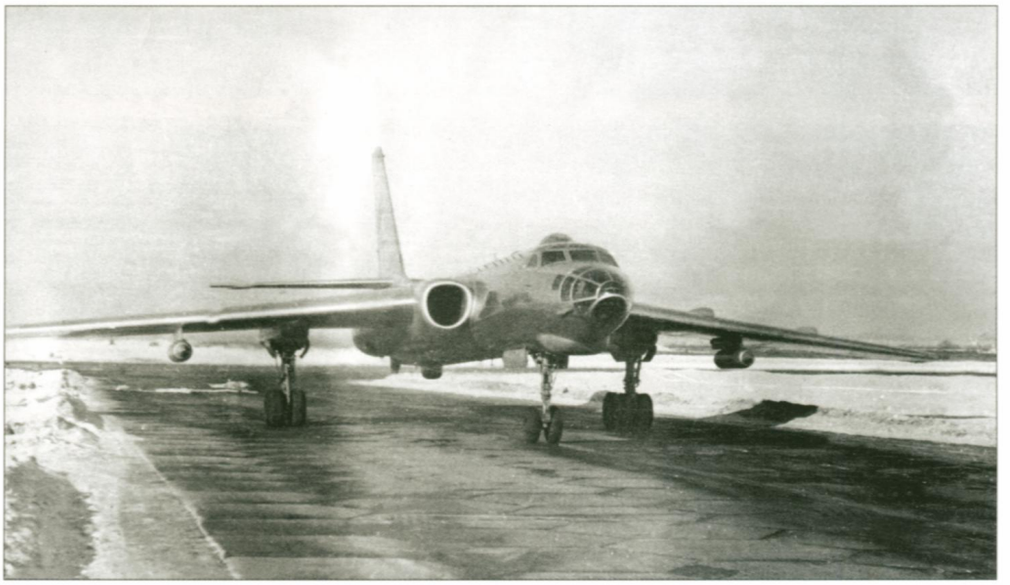
Tu-16RM Reconnaissance Aircraft

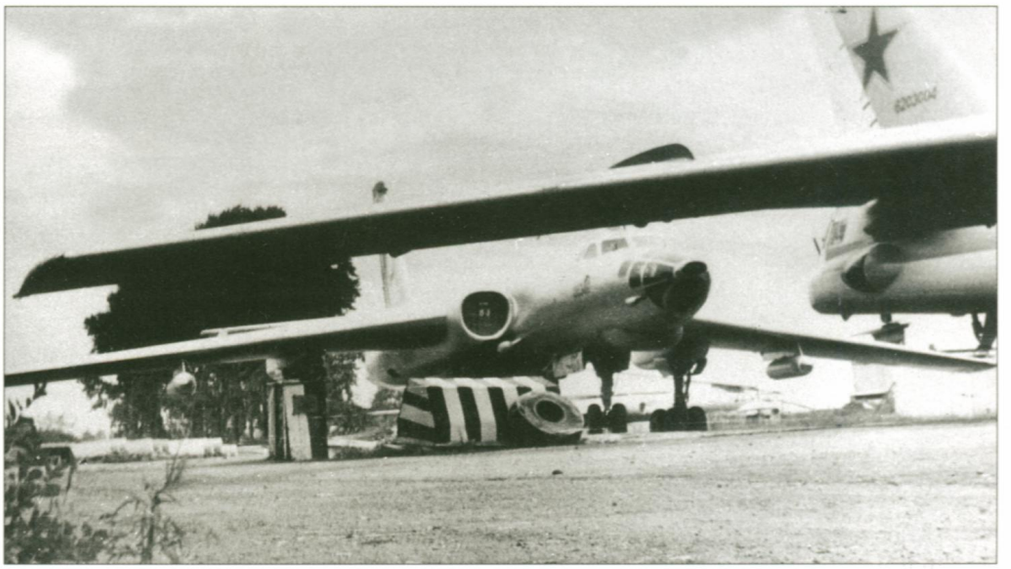
In the late 1970s and early 1980s a number of Tu-16Rs was re-equipped as the Tu-16RM (*raz**ved**chik modernii**zee**rovannyy* – reconnaissance aircraft, modified). The Tu-16RM carried the more sophisticated AFA-41/20. AFA-42/20, AFA-42/75, AFA-42/100 and NAFA-MK-75 cameras, the SRS-4 Kvadrat ELINT set and the RBP-4 radar gave place to the Rubin-1K which had better target resolution. The SRS-1 and SRS-3 were removed. Externally the Tu-16RM differed from the Tu-16R in lacking the latter's underwing SRS-3 pods and having different dielectric fairings for the Rubin-1K radar and SRS-4 antennas.

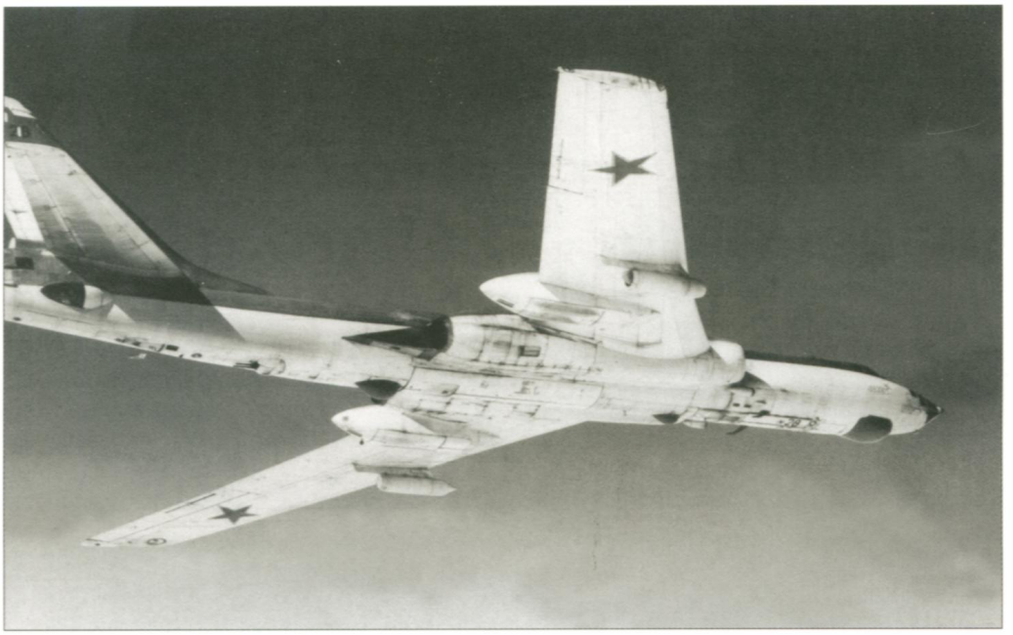
Tu-16RM-1 Maritime Reconnaissance Aircraft

The need for a more specialised maritime reconnaissance version of the Tu-16R arose in the late 1950s and early 1960s, and a spin-off of the Tu-16K-10 ASM carrier was chosen as the most suitable option for Naval Air Arm needs. Two examples of the Tu-16K-10 nearing the end of their service lives were chosen for conversion as the Tu-16RM-1 prototypes (*raz**ved**chik mor**skoy*** – reconnaissance aircraft, naval), the work being carried out by the Navy's maintenance services under the supervision of Tupolev's OKB-156. The movable missile pylon and launch equipment was removed, the weapons bay faired over and a specialised YeN-R radar installed in the nose (it was outwardly distinguishable from the YeN by the slightly enlarged chin radome). Three ventral teardrop antenna fairings were provided for the SRS-1 (forward and aft) and the SRS-4 (central and slightly larger than the other two). The ELINT system was operated from a ventral pressurised cabin. Conventional AFA-33/20M (vertical) and AFA-42/75 (oblique) cameras were also carried, and some Tu-16RM-1s carried SPS-1 and SPS-2 ECM sets. The maritime reconnaissance version was accepted for service in the early 1960s; since series production of the Tu-16 ended in 1963 and no new-build aircraft were available, 11 (12, according to some sources) Tu-16K-10s were converted to Tu-16RM-1 configuration.



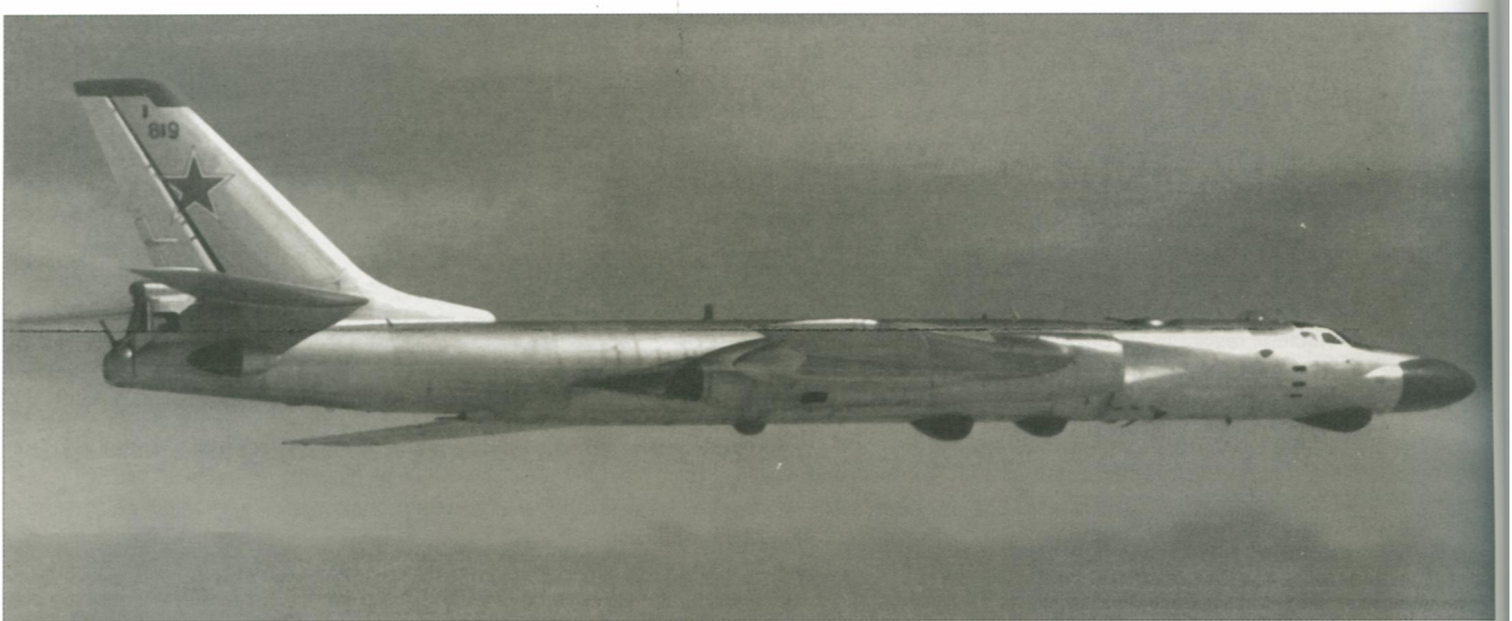




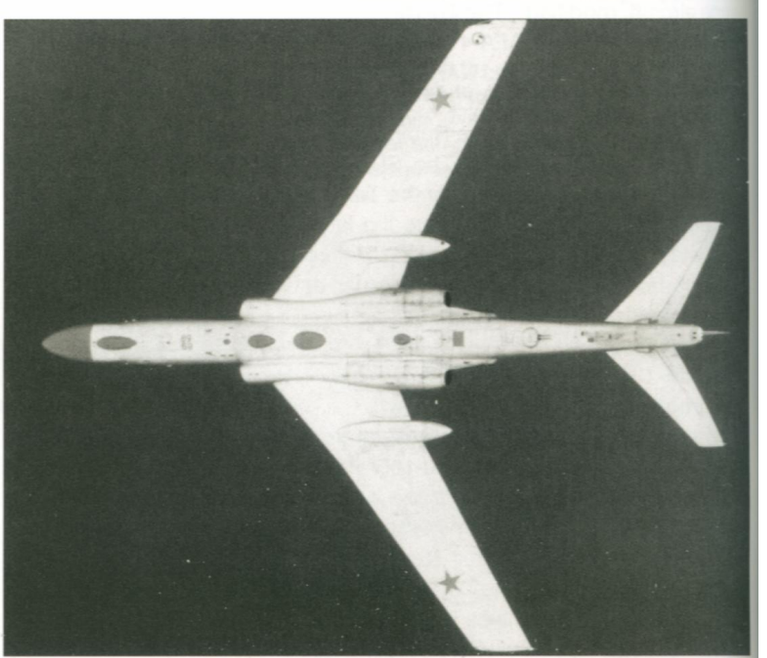


This air-to-air shot of Tu-16RR(ZA) c/n 1883305 at a later date, now upgraded with additional ELINT/ECM equipment, repainted and recoded '28 Red', shows the starboard RR8311-100 air sampling pod in action. The movable nosecone is retracted and the rear shutter turned through 90°, enabling an unrestricted airflow; compare with the inactive pod on the port wing station. Note also the refuelling receptacle under the port wingtip. *Jane's All the World's Aircraft*

A number of Tu-16K-10s were converted to Tu-16RM-1 and Tu-16RM-2 maritime recce aircraft; '89 Red' is one of them. This view clearly shows the ventral blister radomes, the enlarged chin radome and dorsal blade aerial. *Jane's All the World's Aircraft*



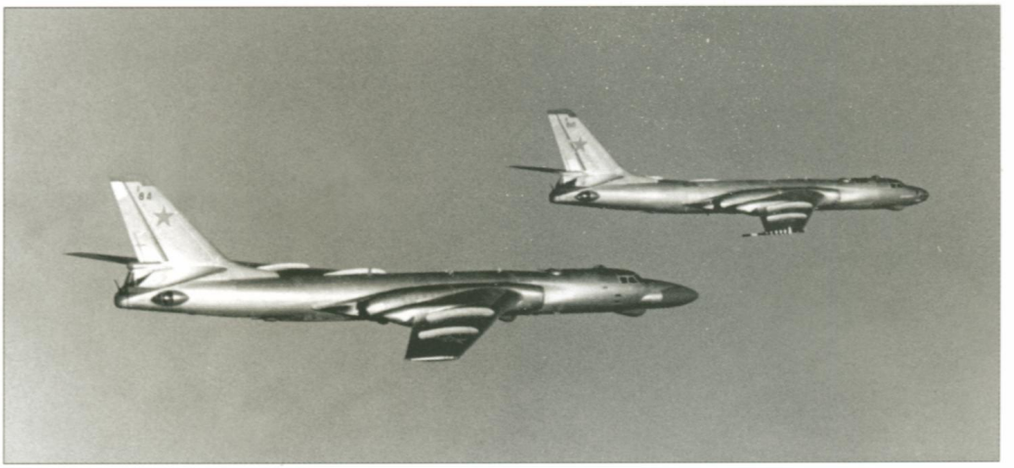
An upper view of the same Tu-16RM-1 or Tu-16RM-2 cruising over thick clouds. As the horizontal 'winglet' on the port wing reveals, the aircraft used to be an IFR-capable Tu-16K-10(ZA). *Jane's All the World's Aircraft*



Lower view of the same aircraft; its Western shadower really made an effort to get a picture from every possible angle! Note the IFR receptacle. *Jane's All the World's Aircraft*

A Tu-16RM-1 or Tu-16RM-2 coded '84 Black' formates with a Tu-16(Z) tanker, ready to take on fuel. Yefim Gordon archive

Below and bottom: **A Tu-16SPS ECM aircraft. This version can be discerned from the SRS-1/SRS-4 equipped Tu-16R by the equal size of the ventral dielectric blisters.** *Jane's All the World's Aircraft*



Aside from reconnaissance, the Tu-16RM-1 could provide mid-course guidance for K-10 ASMs launched by Tu-16K-10 and Tu-16K-10-26 aircraft. This version had the NATO code-name *Badger-D*.

Tu-16RM-2
Maritime Reconnaissance Aircraft

Twelve (or eleven) Tu-16K-10Ds were also modified as maritime reconnaissance aircraft. They were converted to carry the same equipment as the Tu-16RM-1 but designated Tu-16RM-2.

Tu-16RTs Experimental Maritime Reconnaissance / OTH Targeting Aircraft

In 1956 OKB-52 headed by Vladimir N Chelomey began preliminary design studies for the P-6 shore-launched anti-shipping cruise missile. It appeared in 1962/63, successfully passing its State trials, and was accepted for use with Project 651 and 675 submarines. The P-6 could be launched while the submarine was submerged. Work proceeded in parallel on an airborne target detection and over-the-horizon (OTH) targeting system able to transmit target data directly to the submarine. After missile launch, the aircraft would provide mid-course guidance.

Three aircraft were converted into the prototypes of the maritime reconnaissance/OTH targeting version designated Tu-16RTs (*raz**ved**chik-**tsel**eooka**za**tel'*). Their Rubin radar was replaced by an *Oos**pekh*** (Success) radar whose antennas were housed in large teardrop radomes near the bomb bay.

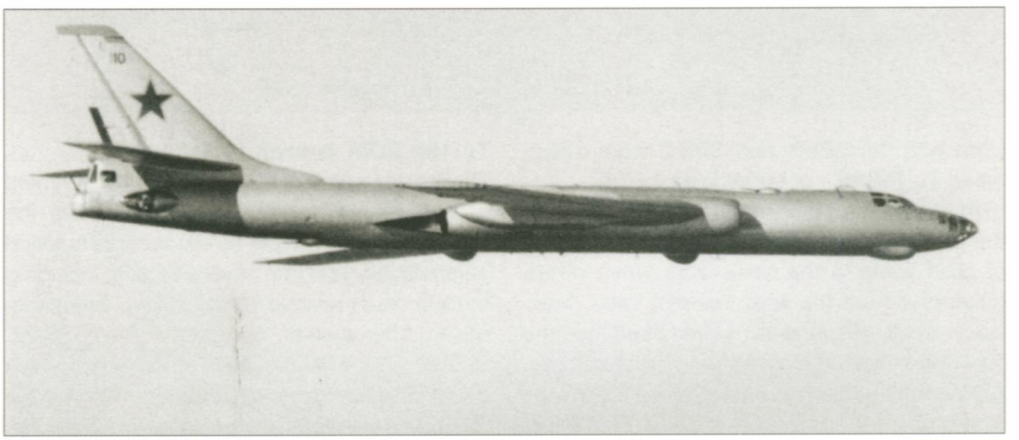
The P-6 was accepted for service with the Soviet Navy in 1965, but the Tu-16RTs was not. It did, however, take part in tests of the reconnaissance and target-indicator equipment fitted to production Tu-95RTs machines filling the same role.

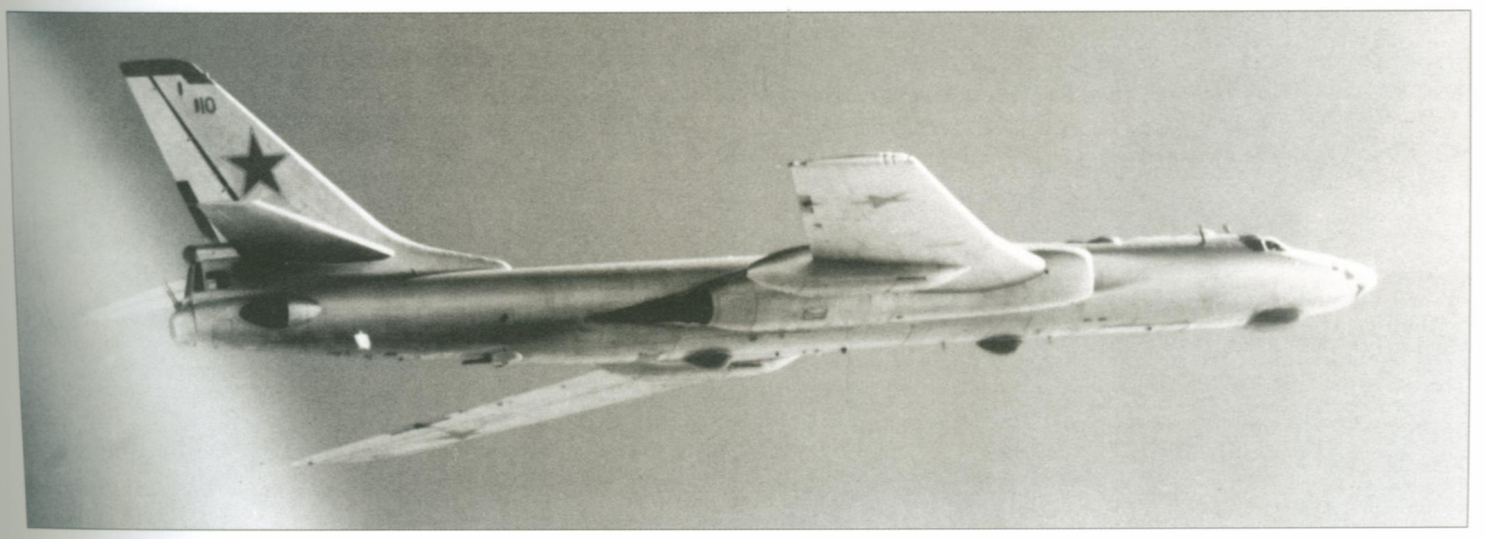
Tu-16SPS ECM Aircraft

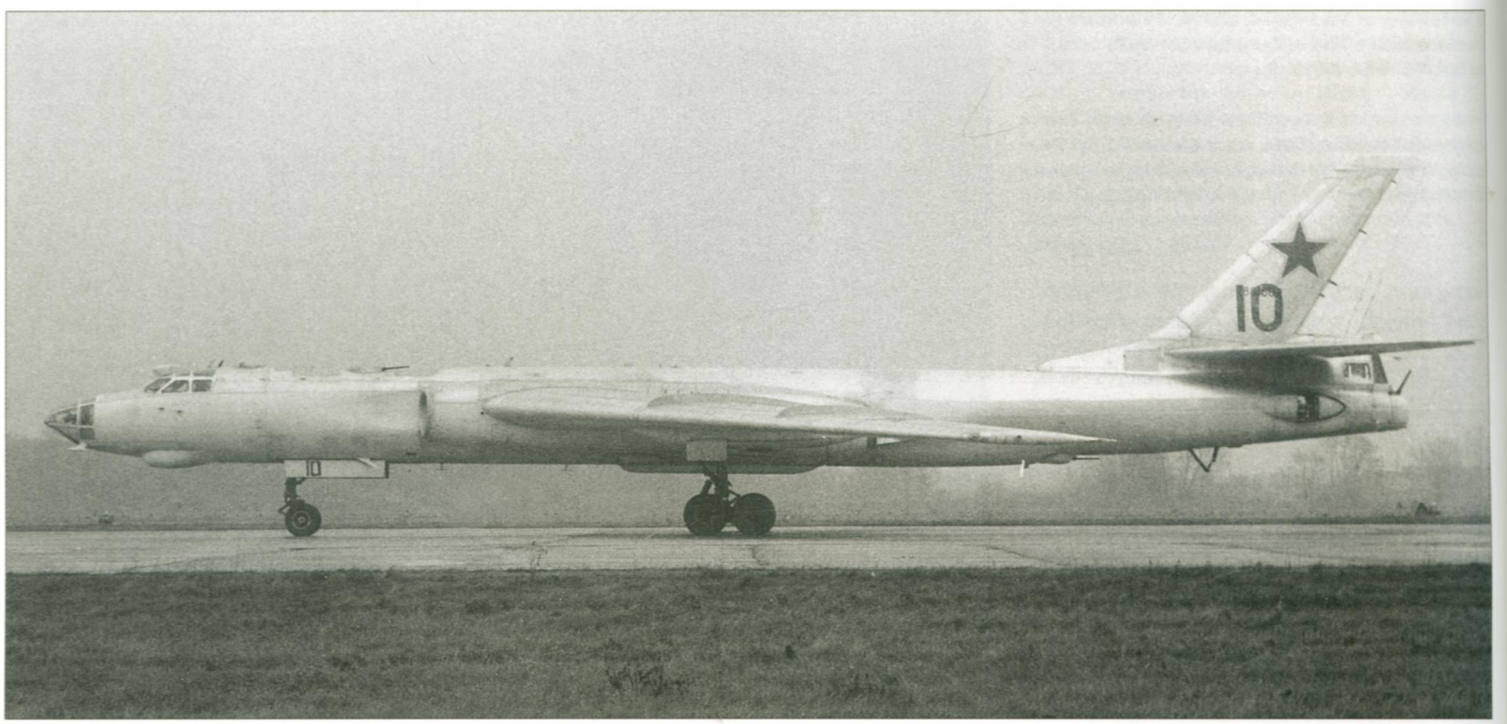
The first SPS-1 and SPS-2 active ECM sets installed in the Tu-16 in the 1950s were designed for group protection of strike aircraft formations and were relatively unsophisticated, with low emission power; besides, they were bulky and heavy. Basically, they were intended to jam AA artillery, land, shipborne and airborne radars produced in the 1940s. The SPS-1 and SPS-2 required an additional crewmember to operate them who had first to detect the enemy radar, establish its frequency and then tune his ECM set accordingly. All this could take a well-trained operator three minutes – too long if the aircraft was flying at low altitude. Added to this was the inability of the SPS-1 and SPS-2 to jam multi-channel and tuneable radars effectively.

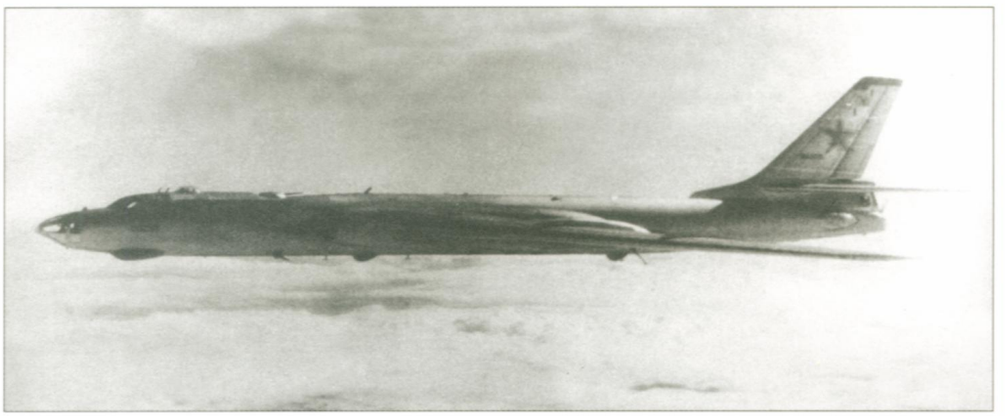
Production of Tu-16s fitted with the SPS-1 and SPS-2 jammers began in 1955. During 1955-56 plant No 1 in Kuibyshev produced 42 aircraft with SPS-1 sets, plus another 102 machines with the SPS-2 in 1955-57, including four IFR-equipped examples.

Like the Tu-16R, this version designated Tu-16SPS (***stahn**tsiya po**mekh**ovykh sig**na**lov* = active jammer) had a removable pressurised compartment in the aft part of the bomb bay for the electronic warfare officer (EWO), the forward section still remaining usable as a bomb bay. The two antennas for the SPS-2, covered by teardrop fairings, were housed in the lower part of the fuselage fore and aft of the bomb bay. The whip aerials for the SPS-1 could be sited either dorsally (aft of the WSO's blister) or ventrally (forward of the bomb bay). Aircraft









Above: **'10 Red' (c/n 1881602), a standard Tu-16P Buket ECM aircraft.** Yefim Gordon archive

Left: **'20 Red' (c/n 1882605), a Tu-16SPS.** *Jane's All the World's Aircraft*

Bottom left: **This publicity shot of a Soviet Air Force crew posing with their Tu-16P Buket illustrates the four heat exchangers flanking the ventral canoe fairing of the Buket jammer.** Sergey and Dmitriy Komissarov archive

Bottom right: **A pair of Tu-16Ps, '06 Red' (c/n 8204008) and '08 Red' (c/n 8204009), flies in echelon starboard formation. The picture was most probably taken from a Tu-16(Z) tanker.** Yefim Gordon archive

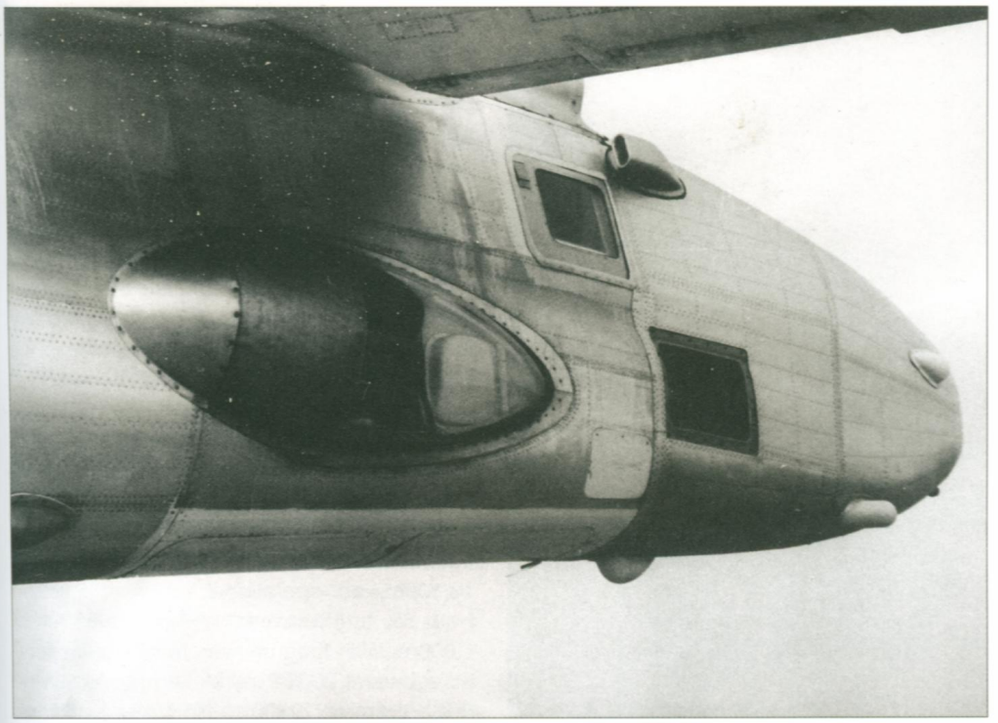
fitted with the SPS-1 and SPS-2 were designated Tu-16SPS – or sometimes Tu-16P.

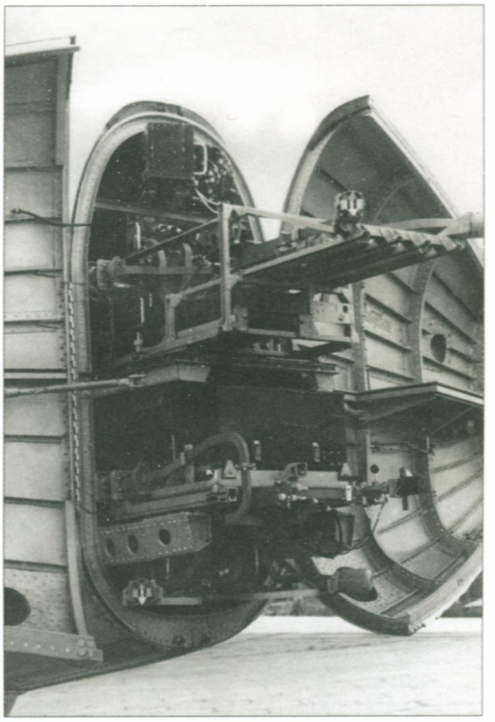
At first the Tu-16SPS was not equipped with the ASO-16 chaff dispenser, and the absence of chaff vents in the bomb bay doors distinguished it from the later Tu-16E. Later, however, chaff dispensers were fitted to the Tu-16SPS and the difference disappeared. During the 1960s, almost all the Tu-16SPS still in service were refitted with the Buket ECM set.

Tu-16P ECM Aircraft (*izdeliye* NP)

The Buket system of automated active jammers was developed in the late 1950s. Unlike the SPS-1 and SPS-2, these new sets could function automatically and jam several radars, including multi-channel and tuneable radars, simultaneously. The system comprised the SPS-22, SPS-33, SPS-44 and SPS-55 sets, each of which could cover a certain waveband. In its day the Buket was the world's most powerful ECM suite, and existing means of overcoming ECM were ineffectual. To maintain its function, the enemy radar could only change its operating frequency, but even then there were four Buket systems, each with its own range of frequencies: B-2 (21.5-30cm wavelength), B-3 (12.5-21.5cm), B-4 (9.8-12.5cm) and B-5 (8.6-9.8cm).

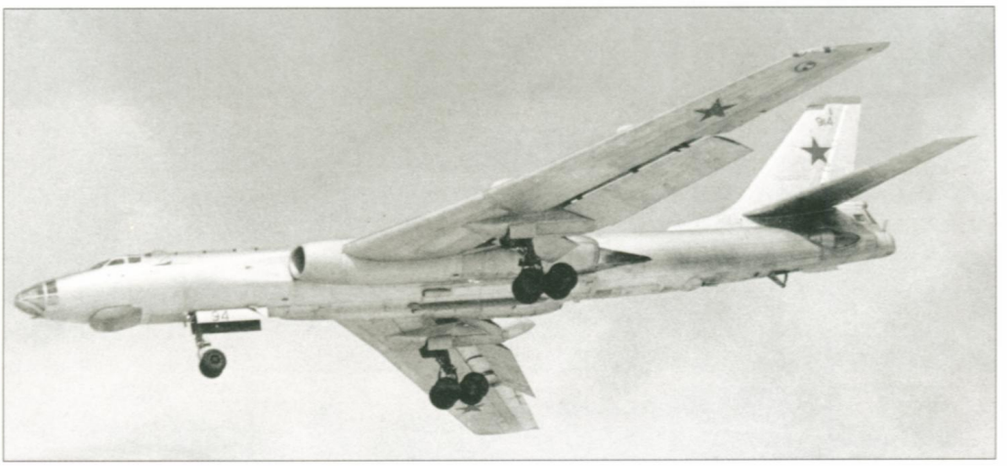
Each system had four generating transmitters with different wavelengths (except the Buket-3 which had six), enabling it to cover the





whole spectrum of wavelengths. The Buket sets (B-2, B-3, B-4 and B-5) had a range of reception channels (18, 45, 30 and 30 respectively) and ratings of 340-1000 watts, 500-100 watts, 440-680 watts and 400-860 watts respectively). The B-2 set weighed 854kg, the B-3 870kg, the B-4 722kg and the B-5 755kg. Ground radars were jammed with full 360° coverage, and the Buket sets could function either automatically or semi-automatically. This automatic capability meant that an additional crewmember was not required, and they could be operated by the navigator-operator from his normal crew position.

The Buket sets were installed in the Tu-16 from the early 1960s onwards. They were intended to counteract enemy long-range ground detection and guidance radars and surface-to-air missile (SAM) sites. From an altitude of 10,000-11,000m one ECM aircraft could protect a whole formation of attack aircraft within a radius of 3,000 to 5,000m.



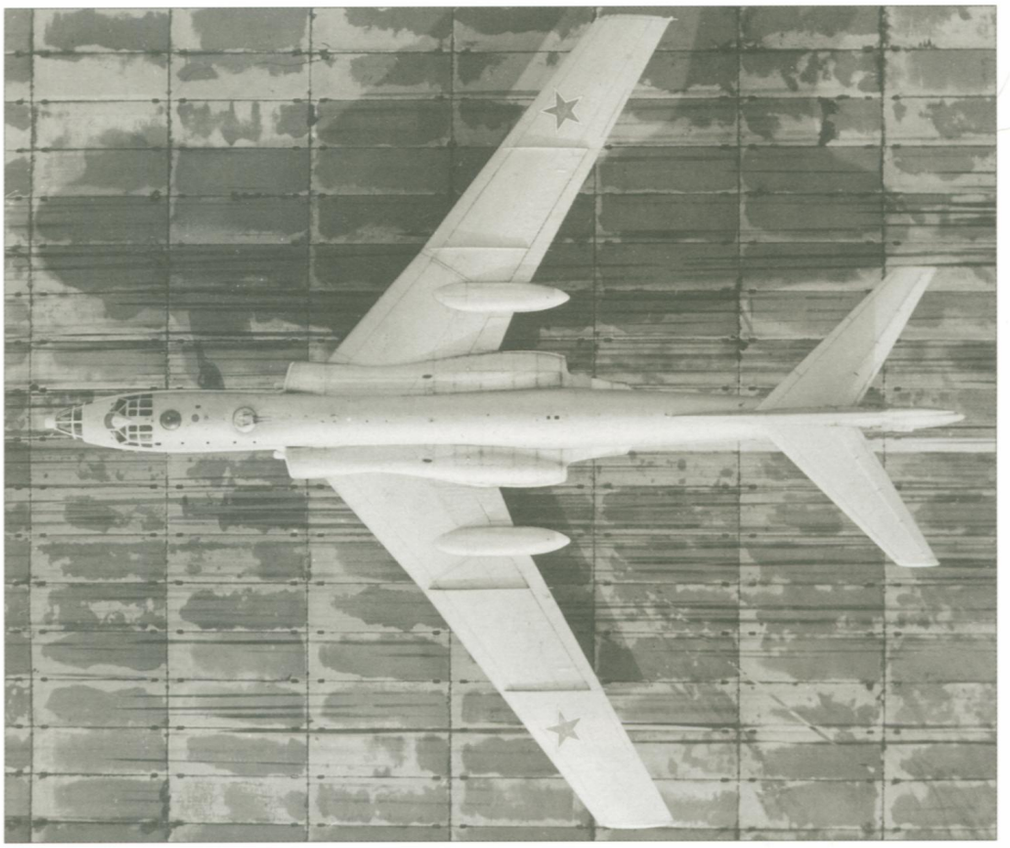
Top left: **Close-up of the massive tail fairing housing the SPS-100 Rezeda active jammer. The small dielectric blisters conceal the actual emitter antennas.** Tupolev JSC

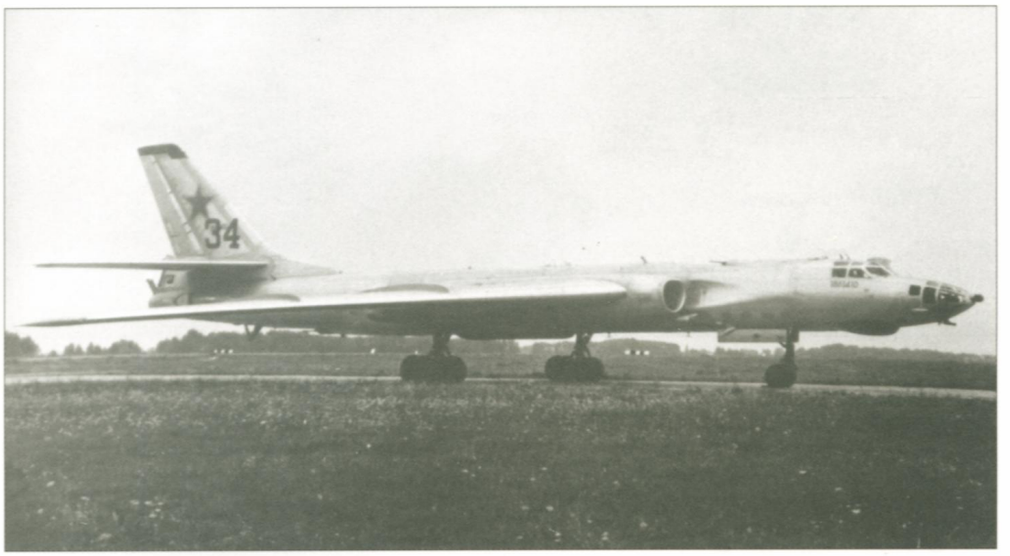
Top right: **The same fairing opened for maintenance, showing the equipment rack of the SPS-100 and the emitter antennas which are positioned under the dielectric blisters on the fairing.** Tupolev JSC

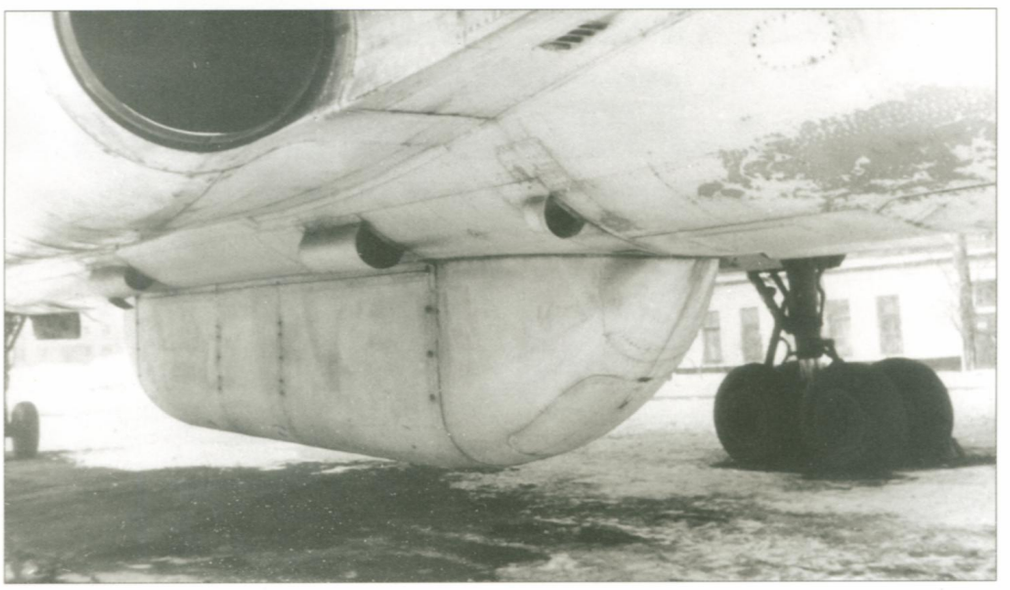
This Tu-16P ('94 Red', c/n 5202602) was converted from a Tu-16A. Yefim Gordon archive

This Tu-16P ('42 Red', c/n 1881305) features a UKhO rear ECM fairing housing a Siren' (SPS-151, SPS-152 or SPS-153) jammer and ECM antennas on the forward and centre fuselage. Note that the tactical code is painted twice on the nose gear doors. Yefim Gordon archive

Front view of Tu-16P c/n 1881305. Yefim Gordon archive







The Buket suite was first fitted to the Tu-16 in 1962. In the course of the 1960s, 34 aircraft had the SPS-22N installed, nine aircraft received the SPS-33N, 28 the SPS-44N and 20 the SPS-55N. Not only the Tu-16SPS but also the Tu-16 Yolka was modified to carry the Buket system, as were several other versions. If the aircraft undergoing conversion had a mission equipment operator's pressurised cabin in the weapons bay, this was deleted – the Tu-16P with the Buket suite had the normal Tu-16 complement of six crewmembers. The power of the ECM sets meant that maintenance personnel on the ground had to observe rigorous safety measures when they were switched on.

The Tu-16P operational in the 1960s had a maximum take-off weight of 75,800kg, a top speed of 1,000km/h at an altitude of 6,250m (and 980km/h at 10,000m), a service ceiling of 13,100m, an operational range of 5,800km (with 5% fuel reserves) and a take-off run of 1,800m. With the transition to low-level operations several Tu-16P were re-equipped with the SPS-77 jammer optimised for these conditions. During the 1970s and 1980s the ECM equipment was constantly updated. The Tu-16P carried the SPS-151, SPS-152 or SPS-153 individual and formation protection ECM sets belonging to the Siren' series. These were located in the equipment bay and in the UKhO rear ECM fairing replacing the DK-7 tail turret. The transmitter antennas were mounted along both sides of the fuselage near the engine air intakes, and the receiver antennas in the aircraft's nose. The Tu-16P had the NATO codename *Badger-J*.

Tu-16P Ficus ECM Aircraft ('order 2231')

Experience with the Tu-16P revealed that when aircraft were flying in close formation the Buket suite not only jammed enemy ground radars but disrupted the operation of the bombers' own radars. It was therefore necessary to modify the Buket in order to narrow the angle of its powerful jamming signal. A crash programme to resolve this problem resulted in ten Tu-16Ps with the Buket system (SPS-22N and SPS-44N) being modified from 1970 onwards to work with the Ficus array ('order 2231'). Tests were carried out using Tu-16Ps c/ns 1882409 and 1883117.

The Ficus was intended to increase the energy potential of the Buket suite by narrowing its directional angle in both the vertical and

A rare upper view of Tu-16P c/n 1881305. Yefim Gordon archive

Tu-16P Buket '34 Blue' (c/n 1881410) combines the ECM antennas on the forward and centre fuselage with a standard tail gunner's station. Yefim Gordon archive

The Tu-16P Ficus is identifiable by the much larger ventral canoe fairing. This is '80 Red' (c/n 8204212). Yuriy Kabernik archive

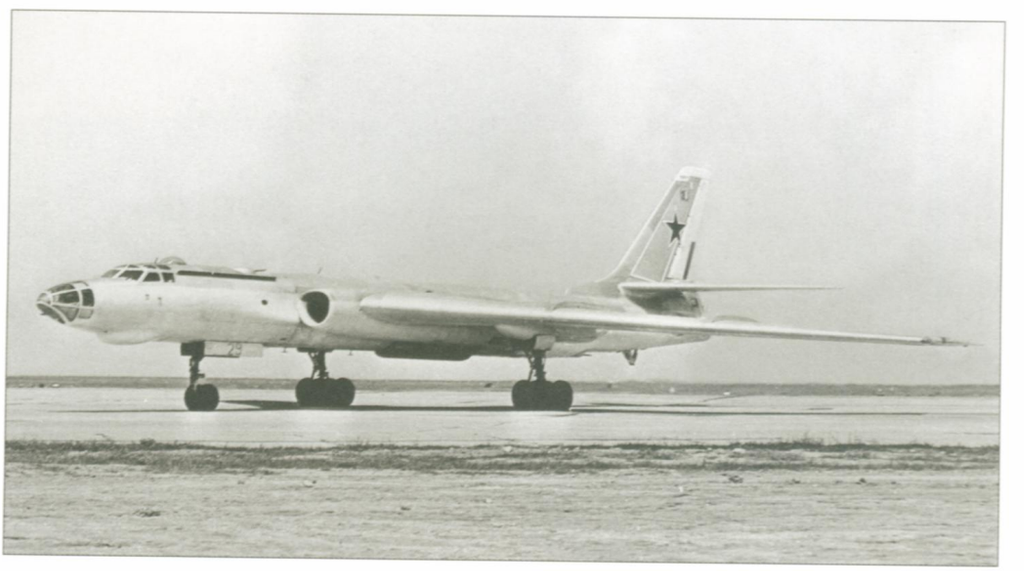
horizontal planes and directing its jamming signal either to port or starboard. The apparatus was handled by the weapons systems operator, weighed 232kg and consisted of five revolving directional antennas with a drive mechanism located in a large ventral dielectric fairing. The Tu-16P fitted with the Ficus system provided more effective protection for a formation of aircraft than previously.

Tu-16P Cactus ECM Aircraft

Some Tu-16Ps were re-equipped to carry the SPS-120 Cactus' on a platform in the equipment bay, with a large antenna under the platform itself. Access to the equipment was via two hatches in the platform and in the antenna fairing. The 'Cactus' was handled by the navigator-operator and thus the number of crew members was unchanged.

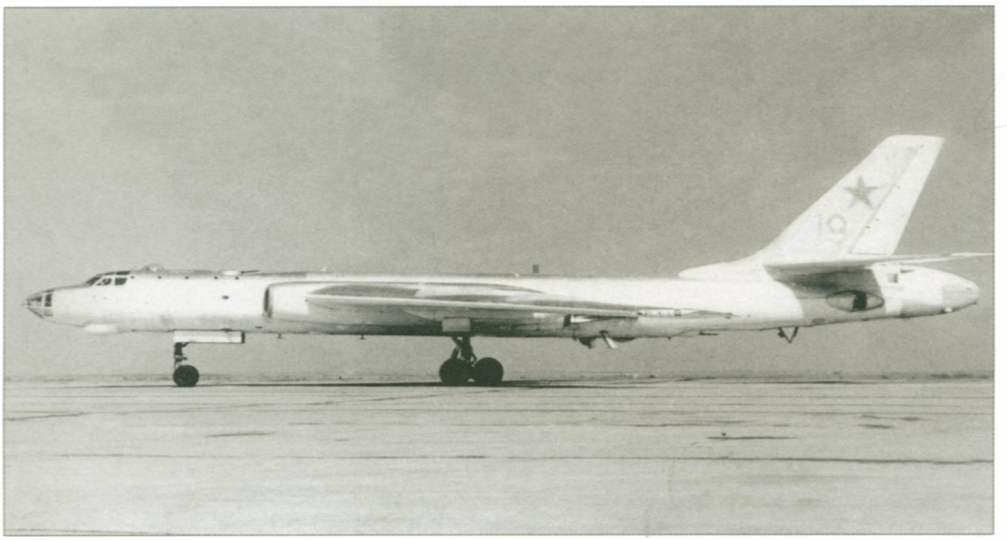
Tu-16P Rezeda Experimental ECM Aircraft

In the second half of the 1960s a production Tu-16P ('17 Red', c/n 5202907) was fitted with an SPS-100 Rezeda-AK jammer. The tail turret and PRS-1 gun-laying radar were removed and replaced by a new conical fairing housing the



Top: **This Tu-16P Buket coded '01 Red' (ex-'28', c/n 1882205) is a gate guard at Shaikovka AB.** Yefim Gordon archive

Right and below: **This Tu-16P Buket ('29 Red', c/n unknown) was used for some sort of development work. Note that the fin torsion box is outlined in white.** Tupolev JSC

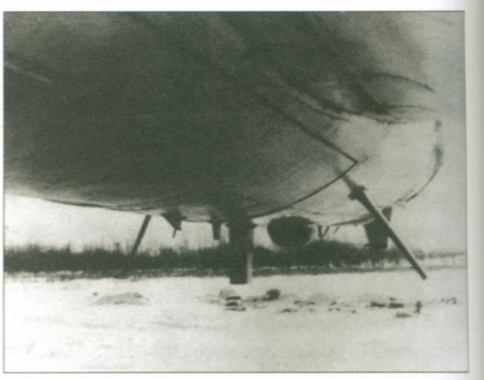


Top left: **'19 Red', the prototype of the Tu-16 Yolka ECM aircraft, showing the ventral chaff outlets. The aircraft is additionally equipped with an SPS-100 active jammer.** Tupolev JSC

Top right: **Close-up of the chaff outlets characterising the Tu-16 Yolka.** Viktor Kudryavtsev archive

Centre: **Very weathered-looking Tu-16 Yolka '09 Red' (c/n 1882306).** Yefim Gordon archive

Above: **Tu-16 Yolka '53 Red' flies over the Russian countryside, with three sister ships cruising at a lower level.** Yefim Gordon archive



SPS-100. The aircraft was also equipped with an SPO-3 Sirena-3 RWR which was part of the SPS-100 package. Tests of the SPS-100 proved successful, but operational Tu-16s were not re-equipped with it, although several combat and specialised versions of the Tu-16 were fitted with the Rezeda-AK from 1969 onwards. The prototype ended its days as an M-16 remote-controlled target drone at GK NII VVS in Akhtoobinsk.

Tu-16 Silikat and Tu-16 Fonar' Experimental ECM Aircraft

According to Council of Ministers directive No 1659-657 of 3rd July 1953 and MOP order No 521 of 18th July the Silikat ECM set designed for jamming ground and shipborne radars working in the 21.8-30.5cm waveband was to be installed in a Kuibyshev-built Tu-16 (c/n 1882106) for testing in the late spring or early summer of 1955. However, this was never done; instead, the new Fonar' (Lantern, or Streetlight) ECM system was installed somewhat later. Neither system was placed in series production.

Tu-16 Yolka Passive ECM Aircraft ('order 214')

In parallel with the development of the Tu-16SPS active ECM aircraft, OKB-156 worked on a passive ECM version designated Tu-16 Yolka (Spruce – or, if you like, New Year Tree) which was produced at both the Kuibyshev and Voronezh factories from 1957 onwards in accordance with 'order 214'. This aircraft carried seven ASO-16 Avtomat-1 automatic chaff dispensers in its cargo hold which was provided with chaff outlets (three in the port bomb bay door and four in the starboard door). The remaining section of the bomb bay was available for bomb carriage.

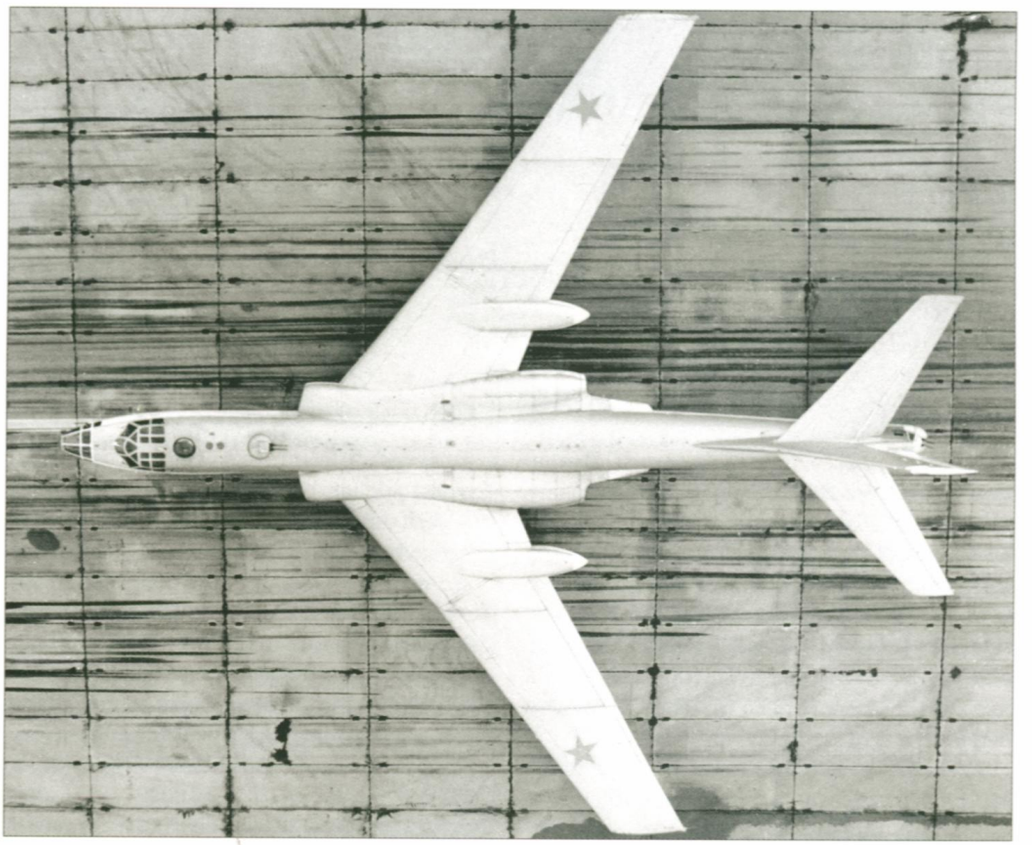
In addition to the chaff dispensers, an SPS-4 *Modul**ya**tsiya* (Modulation) radar jamming set was installed under a teardrop fairing forward of the bomb bay. The antenna of the SD-1 distance measuring equipment (DME) was housed in the bomb bay, and its forward section protected against damage by the ejected chaff by a special cover.

When the ASO-16 chaff dispensers were not installed the entire bay was available for carrying bombs, but in the 1950s the seven ASO-16s were augmented by two APP-22 chaff dispensers (*avto**maht** posta**nov**ki po**mekh*** – auto-

A fine shot of Tu-16E '45 Red' (c/n 1882411). Yefim Gordon archive

An upper view of the same aircraft. Yefim Gordon archive

'69 Red' (c/n 8204214) is an example of the Tu-16E Azaliya (note the two small hemispherical ventral blisters) ahead of the main gear and the dorsal intakes and outlets of the Azaliya jammer's heat exchangers). It is equipped with a UKhO tail fairing housing a Siren' jammer. Yefim Gordon archive



matic [passive] ECM device). In this case no bombs could be accommodated. Some machines were fitted with the ASO-2B and ASO-2I-E7R versions. Externally the Tu-16 Yolka could be distinguished from the bomber version by the teardrop fairing for the SPS-4 forward of the bomb bay and by the chaff outlets along the bomb bay doors.

In 1957 plant No 1 produced 42 Tu-16 Yolkas equipped for in-flight refuelling, and a further ten were produced in that year by plant No 64. This version was not built at plant No 22 in Kazan', although 19 of the 44 Tu-16 bombers built here were modified to Yolka configuration (all possessing IFR capability). Thus, altogether, the Soviet Air Force took delivery of 71 examples of the Tu-16 Yolka which were later updated and modified more than once so that they resembled the Tu-16P in their mix of passive and active ECM equipment.

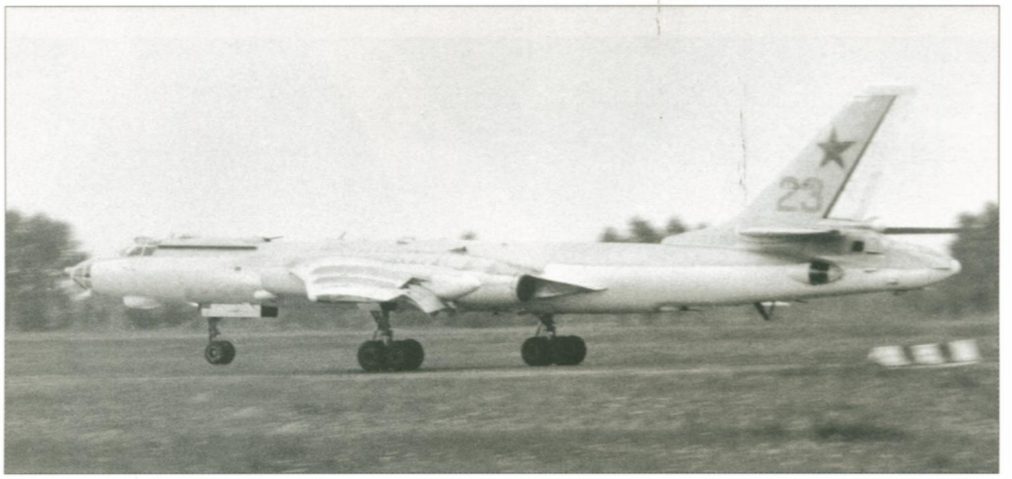
During production the Tu-16 Yolka was referred to as 'order 214'. Later some were modified under the terms of 'order 212'.

The Tu-16E ECM Aircraft (*izdeliye* NE)

Yet another passive ECM version designated the Tu-16E or *izdeliye* NE (in Soviet Air Force units it, too, was known as the Tu-16 Yolka) resembled the Tu-16R in its equipment. As on the reconnaissance version, a special cabin was installed in the aft section of the weapons bay for the operator of the SPS-1, SPS-2 or SPS-2K jammer (the latter model was called *Pion* – Peony) with its antenna mounted under the operator's cabin. The cabin (similar to that fitted in the Tu-16R) had life-support systems and control mechanisms for the ECM set. The bomb bay also featured mounting racks for two ASO-16 chaff dispensers. Bombs could be carried in the forward section of the bomb bay. Later, additional ASO-16 chaff dispensers were housed in the forward section, as well as two APP-22 chaff dispensers, with appropriate modifications to the bomb bay doors; this greatly improved the aircraft's ECM capability at the expense of the offensive armament.

Between 1957 and 1959, 51 examples of the Tu-16E were produced at plant No 1; another 38 were built by plant No 22 in 1958. All possessed IFR capability. The Tu-16E differed externally from the Tu-16 Yolka in having an access hatch for the EWO's cabin cut in the bomb bay doors. The Tu-16E was given the NATO codename *Badger-H*.

A head-on view of Tu-16E Azaliya '69 Red' (c/n 8204214). Yefim Gordon archive



Tu-16E Azaliya '23 Blue' takes off on a training mission. Yefim Gordon archive

Tu-16E Azaliya ECM Aircraft

During the 1970s a number of Tu-16 Yolka and Tu-16E ECM aircraft were modified *in situ* to carry SPS-61, SPS-62, SPS-63, SPS-64, SPS-65 or SPS-66 jammers which had the common name ***Aza**liya* (Azalea); such aircraft were accordingly known as the Tu-16E Azaliya. As a rule, the SPS-63 or SPS-66 was fitted. Many also had jammers of the Siren' family fitted.

According to MAP order No 121 of 19th April 1972 the Tu-16E had its DK-7 tail turret, PRS-1 Argon gun ranging radar, ASO-16 chaff dispenser, SPO-2 RWR and SPS-2 jammer removed. These were replaced by one of the Azaliya-U series jammers, an SPS-151 Siren'-1 jammer, an SPS-151M Siren'-1M jammer, two SPS-152 Siren'-2 jammers, two SPS-153 Siren'-3 jammers, a *Be**ryo**za-P* (Birch-P) radar homing and warning system (RHAWS) and an ASO-2I chaff/flare dispenser

The Siren' sets were installed in the familiar UKhO conical fairing replacing the tail turret. Aircraft with the SPS-61, SPS-62 and SPS-63 also carried an SPS-6 Los' (Elk) jammer for collective protection, while those with the SPS-64, SPS-65 and SPS-66 had the SPS-5 Fasol' (String Bean). The antennas for the Azaliya were housed in teardrop fairings under the fuselage in the forward or aft section of the bomb bay, the remainder of the bay being used to carry bombs or ASO-16 and APP-22 chaff dispensers. When the Azaliya was installed on the Tu-16 Yolka, the antenna was located in the forward section of the weapons bay; on the Tu-16E it replaced the entry hatch of the EWO's cabin (which was removed).

Some examples of the Tu-16 Yolka and Tu-16E Azaliya had active jammers of the SPS-100, SPS-100A and SPS-100M type, and at least some had the SPO-15 Beryoza RHAWS. During their service life the aircraft were constantly modified and updated in line with other versions of the Tu-16.

Tu-16ER Reconnaissance and ECM Aircraft

Some Tu-16Es were re-equipped as the Tu-16ER, which had the SPS-2 ECM set replaced by an SRS-1 ELINT system. This version had a distinctive appearance with its whip antennas for the SPS-1 and SRS-1 sets.

Tu-16E (Tu-16E-KhR) NBC Reconnaissance Aircraft

Yet another ECM version is officially referred to as the Tu-16E, but more commonly as the Tu-16E-KhR (*khi**mich**eskaya raz**ved**ka*). Its equipment fit permitted photographic, electronic and nuclear/biological/chemical (NBC) reconnaissance, and it closely resembled the Tu-16RR. Its ECM equipment merely facilitated its reconnaissance functions. A crew of seven was carried.

The forward section of the equipment bay accommodated a pivoting platform on which two AFA-42/100 cameras were mounted, and the aft section a pressurised operator's cabin. The central section of the bay could be used to carry bombs or up to four ASO-16 chaff dispensers. The wing structure was reinforced so that two pylon-mounted pods (identical to those carried on the Tu-16RR) could be carried for atmospheric sampling. The ECM equipment, apart from the ASO-16, included SPS-5 and SPS-151 sets and two SPS-1s. The antennas for the SPS-5 were mounted under the fuselage forward of the weapons bay, for the SPS-151 beside the engine air intakes and for the SPS-1 aft of the operator's cabin above and below the fuselage.

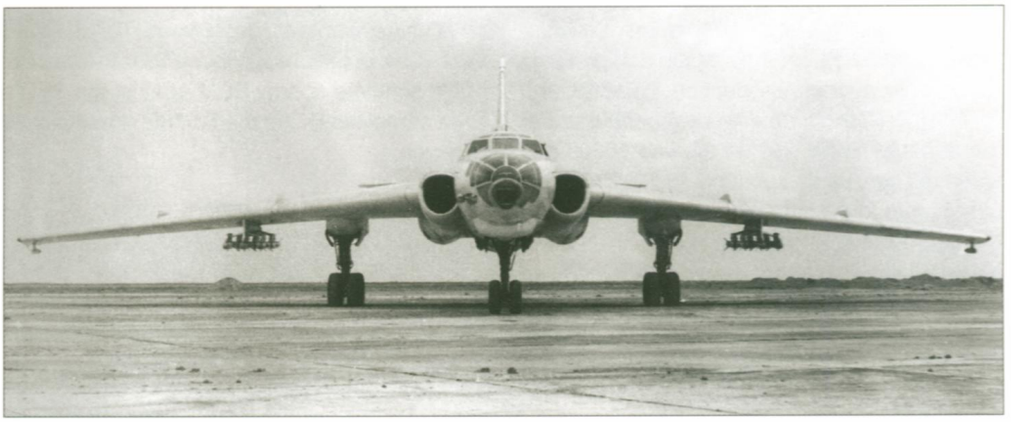
Two aircraft built by plant No 1 in Kuibyshev were refitted in this way. One of them served with the 226th OAPREP (*ot**del**'nyy **avia**polk **rah**dioelek**tron**novo protivo**dey**stviya* – Independent ECM Air Regiment) based initially at Poltava in the Ukraine, between 1978 and 1980 at Priluki (also in the Ukraine) and then from 1980 at Spassk-Dal'niy in the Russian Far East. The second aircraft was based at Spassk-Dal'niy from the start. At Poltava and Priluki these aircraft were referred to as the Tu-16E-KhR. During maintenance work in 1979-1980 the aircraft were fitted with the *Rogo**vitsa* (Cornea) and SPS-152 jammers with the antennas mounted in a small thimble fairing on the navigator's station glazing.

Tu-16P with RPZ-59 ECM Rockets

On 21st July 1959 the Council of Ministers issued directive No 832-372 envisaging provision of a new individual passive ECM system for the Tu-16. Toropov's OKB-134 therefore modified its production K-5 (alias K-51) air-to-air missile as the RPZ-59 (*ra**keta pro**tivo**rah**di-olokatsi**on**noy za**shchit**y* – anti-radar protection missile) known under the codename *Avto**stra**da-1* (Highway-1). Rather misleadingly, the weapon was referred to in Russian as an 'anti-radar missile'; however, it was **not** an ARM – that is, it was designed to disrupt the operation of enemy radars, not destroy them. The RPZ-59 was to be fired by the Tu-16, ejecting clouds of chaff some way ahead of the aircraft to jam AA artillery gun-laying radars, SAM guidance radars and radar homing air-to-air missiles. Six RPZ-59 rockets were to be carried on a special extensible launcher lowered clear of the weapons bay for loading and firing them; the launcher featured an emergency jettison system. The missiles could be fired singly, or automatically at preset intervals.

After preliminary factory testing of the system at OKB-134, combined state trials involving OKB-134, OKB-156 and the Soviet Air Force were held by GK NII VVS, using a modified

Tu-16P '12 Red' (c/n 6400903) was modified by NII-131 for testing the RPZ-59 rockets.



Tu-16P c/n 6400903, showing the underwing racks for the RPZ-59 chaff-dispensing rockets. The purpose of the small fairings under the wingtips is unknown. Both Tupolev JSC

Tu-16P ('47 Red', c/n 8204130) built in 1958 at plant No 22. The trials continued until early 1964 but proved unsatisfactory as the missile turned out to be unstable in flight; also, a number of uncommanded launches occurred. During one test flight in 1963 the missile struck the radome of the RPB-6 Lyustra radar, destroying it; on another occasion the missile collided with the fuselage, making a big dent in it. On 1st July 1963 the State acceptance trials were discontinued at the insistence of the Soviet Air Force owing to the system's poor reliability which put the aircraft and crew in danger.

In 1964, therefore, a new system codenamed *Pi**lon*** (Pylon) was devised, comprising the Tu-16P with a Buket ECM suite augmented by 12 RPZ-59 rockets carried on underwing pylons (hence the name). A Voronezh-built Tu-16P ('12 Red', c/n 6400903) was modified by NII-131 at Pushkin, Leningrad Region – an avionics house which later became LNPO Leninets ('Leninst' Scientific & Production Association) and then the Leninets Holding Co. Further trials were held on this aircraft between September 1968 and May 1969, using an improved version of the RPZ-59. The aircraft logged 39 hours 49 minutes in 19 test flights involving ground radars and the Smerch-A (Tornado-A) fire control radar fitted to the Mikoyan/Gurevich Ye-155P experimental interceptor. The tests proved successful and the Pilon system was adopted for service use with the Tu-16P.

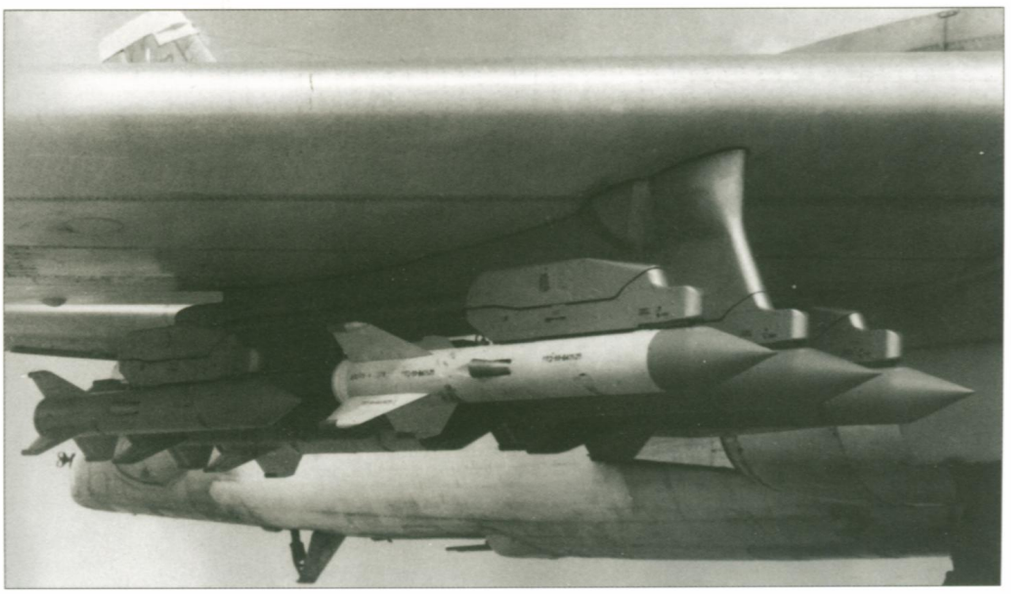
From 1972 onwards a small number of ECM aircraft were adapted to carry the RPZ-59. Externally these differed from the standard Tu-16P in having two underwing hardpoints, each carrying six missiles in tandem groups of three. Each missile weighed around 1,000kg. Before firing the missiles the crew of the Tu-16 had to on put oxygen masks and protective goggles and keep them on until the aircraft had passed the cloud of chaff. With the missiles expended, the centre of gravity shifted forward by 0.5% mean aerodynamic chord; therefore, to maintain a safe CG position after firing the missiles the Tu-16 had to land with a fuel load of at least 2,000kg.

The overall number of Tu-16 versions, including the Tu-16P, is remarkable for the numerous combinations and types of ECM equipment fitted. For example, the 226th Independent ECM Air Regiment based at Poltava had 30 Tu-16s with active ECM equipment, and no two were identical. The new improved ***Klyuk**va* (Cranberry) ECM set with improved performance was installed, and several machines had the SPS-4M Modulyatsiya jammer fitted under the terms of 'order 2615'.

The introduction of infra-red seekers on surface-to-air and air-to-air missiles and the experience gained in local wars compelled the installation of infra-red countermeasures (IRCM) equipment on some versions of the Tu-16, including the Tu-16P. These aircraft had ASO-2I-7ER chaff/flare dispensers in the rear portions of the main gear fairings and in the rear fuselage.

Below left: **This is how the RPZ-59 rockets were loaded by means of hand-driven hoists.**

Below right: **This photo shows well the design of the unusual twin-row six-round launchers.** Both Tupolev JSC



Other Versions and Testbeds

TARGET DRONE CARRIERS

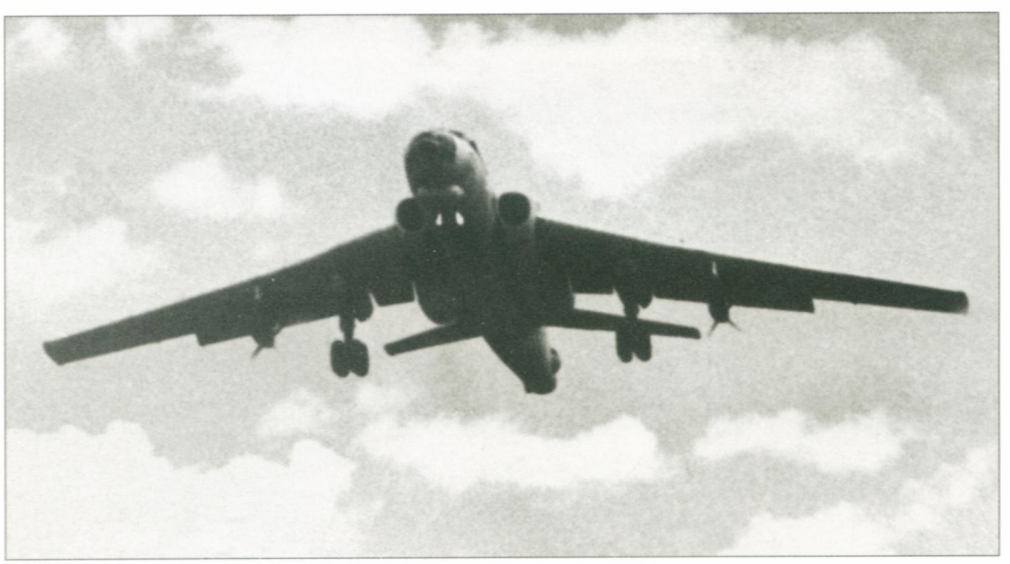
Tu-16KRM ('order 299')

To assist the Air Defence Force (PVO – *Protivovoz**dooshn**aya obor**on**a*) in the development of missiles for use against high-flying supersonic aircraft, production Tu-16KS and Tu-16KSR ASM carriers were modified under the terms of 'order 299' in the late 1960s and given the service designation Tu-16KRM. They carried two MV-1 supersonic high-altitude target drones (MV = *mi**shen'** vy**sot**naya*), alias KRM-2 (*kry**lah**taya ra**ket**a-mi**shen'*** – cruise missile used as target), on underwing pylons. The drones were used in the development of the Tu-128S-4 long-range air defence system comprising the Tu-128 heavy interceptor and the R-4R and R-4T air-to-air missiles.

The MV-1 was a derivative of the KRS-2 cruise missile with a top speed of 2,760km/h at an altitude of 22,500m and a maximum range of 376km. It was flown at altitudes between 20,000 and 25,000m with a flight time of 7.2 minutes and weighed 4,000kg at launch.

The modifications on the Tu-16KRM included changes to the flap operating system (flap deflection was restricted when the drones were carried) and strengthening of the wing spars. There were certain alterations to the fuel system and special equipment to effect the launch of the drones was fitted. The original RBP-4 radar was retained.

A Tu-16 configured as a drone launcher comes in to land, showing the two target drones looking like large bombs carried on underwing pylons. Yefim Gordon archive



Tu-16KRME ('order 299E')

A variant of the Tu-16E ECM aircraft adapted to carry MV-1 target drones but retaining its SPS-1/SPS-2/Siren' jammers and ASO-16 chaff dispenser was designated Tu-16KRME. When the drones were launched, the aircraft could simulate enemy ECM against the PVO's SAM complexes. Like the Tu-16E, it had a crew of seven.

Tu-16NKRM ('order 332')

Appearing in 1964, the Tu-16NKRM known as 'order 332' in production, carried two 540-kg high-speed, high-altitude ITs-59 *O**len'*** (Deer) drones (ITs = *imi**tah**tor **tsel**i* – simulated target) powered by liquid-fuel rocket motors. In 1980 the improved 1,052-kg ITs-59V *Mag**nit*** (Magnet) with a liquid-fuel cruise engine and two solid-fuel rocket boosters became available. Both drones were used by the PVO for SAM development and troop training.

Tu-16NM

The KSR-5NM (D-5NM; M = *mi**shen'***) and KSR-5MV (D-5MV) target drones were evolved by MKB Raduga ('Rainbow' Moscow Design Bureau, pronounced ***rah**dooga*) from the KSR-5N low-altitude cruise missile in the early 1990s. Both drones simulated air-to-surface and anti-shipping air-launched missiles and were used in the development of new SAM systems. The drones could be programmed to simulate high-altitude missiles, strategic or tactical bombers or low-altitude missiles. Depending on the programme, the drone could have a top speed of Mach 4.2, a maximum range of 400km and a maximum flight altitude of 40,000m. The launch weight of both drones was 3,944kg, with a launch altitude between 500 and 11,000m. They were able to carry additional equipment, either in single items or as a set, for measuring the trajectory, transmitting data to measuring stations via data link, recording a miss by an attacking missile and automatically assessing the launch results.

The KSR-5NM (D-5NM) drones were carried by the Tu-16NM modified from a Tu-16K-26 missile strike aircraft. The modifications included strengthened wings, alterations to the flap operating system, changes in the fuel system and a system for pressurising the drone compartments. The KSR-5NM was launched at an altitude of 450-550km/h while the carrier was flying at 500-550km/h. The powered flight time of the drone was between 75.7 and 379.4 seconds over a maximum range of 110.4km. The drones could also be launched by suitably modified Tu-16K-26s, Tu-16KSR-2-5s and Tu-16KSR-2-5-11s.

The Tu-16 Target Tug

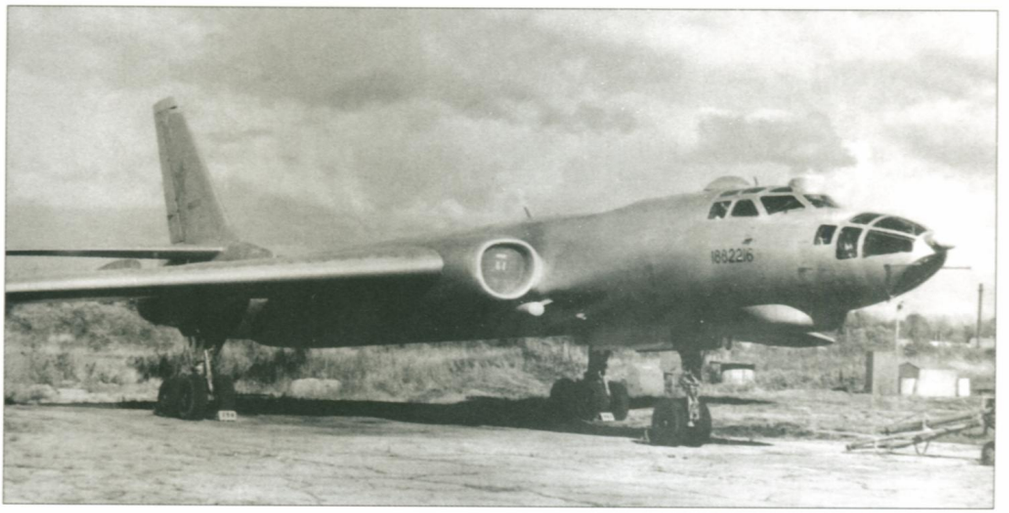
The Tu-16 was also used by the PVO as a tug for the PM-3Zh towed target (*pla**nee**-ruyushchaya mi**shen'*** – gliding target). The tail turret was, in this instance, replaced by the towing gear.

RADIO-CONTROLLED DRONES

In 1956 OKB-156 was called upon to provide a radio-controlled version of the Tu-16 for the PVO. On 23rd November 1956 the Council of Ministers issued directive No 1528-768 followed by MAP order No 592 on 3rd December, both concerning development of the Tu-16M large target drone (M = *mi**shen'***). The aircraft was to retain the flight performance of the production Tu-16 and the first three examples were to be ready for joint OKB/Air Force trials during the second quarter of 1958. Development was to proceed jointly with the Ministry of Electronics (MRP).

Development problems caused delays so that the first three experimental Tu-16M drones did not reach the Tupolev OKB's flight test facility at Zhukovskiy until the end of 1958, allowing tests of the remote control system to begin. Hence on 16th April 1958 the Council of Ministers followed up with directive No 419-198 (and MAP with order No 131 of 24th April), postponing the beginning of the trials until the second quarter of 1959.

This M-16 target drone ('61 Red', c/n 1882216) is presumably a converted Tu-16R with ECM equipment for self-protection still in place. Note the metal panels mounting the forward probe aerials of the radio control system which replace the lower side quadrants of the navigator's station glazing. Yuriy Kabernik



A front view of the same aircraft. The inverted-T shaped aerial under the nose is also associated with the control system. Note the triple struts under the outer wings; these carry marker flares making the aircraft observable at night. Yuriy Kabernik

While the research and development work was under way, during the first six months of 1959 plant No 1 produced 13 Tu-16s (c/ns 1883701 through 1883713) specially for conversion into drones for the PVO. But again progress was hindered by the problems engendered by the creation of a reliable and effective radio control system and in 1960 OKB-156 transferred all further work on the Tu-16 drones to its Tomilino branch headed by I F Nezval'.

The PVO required the Tu-16M to be controlled by radio commands transmitted either from a ground command post or a drone director aircraft. The aircraft was to have both active and passive ECM equipment installed, as well as data link to transmit all the required data to the command post. At first, in accordance with Air Defence Force instructions, the Tu-16M was designed as a pilotless disposable drone. It was to take off with a normal crew on board who would bale out, after which it was planned to use it as a target with the option of self-destruction. The specialists at OKB-156 working with LII, however, devised a system enabling the Tu-16M to take off and land under radio control. The Tu-16M also differed from other types of target drones converted from aircraft in being able to accommodate a large amount of ECM equipment.

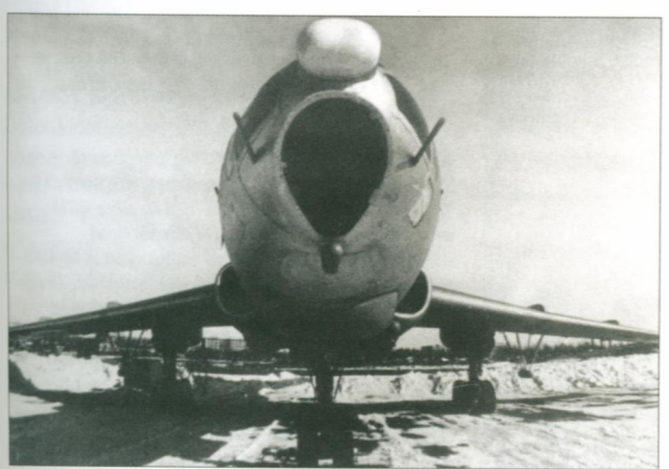
After further development work, the Tu-16M target drone was accepted for use on 17th April 1965 under the designation M-16. By then a considerable number of Tu-16s were reaching the end of their service lives and were modified as M-16 drones. For a brief period the designation Tu-16M was only applied to those drones modified from Tu-16 aircraft at plant No 22 in Kazan'.

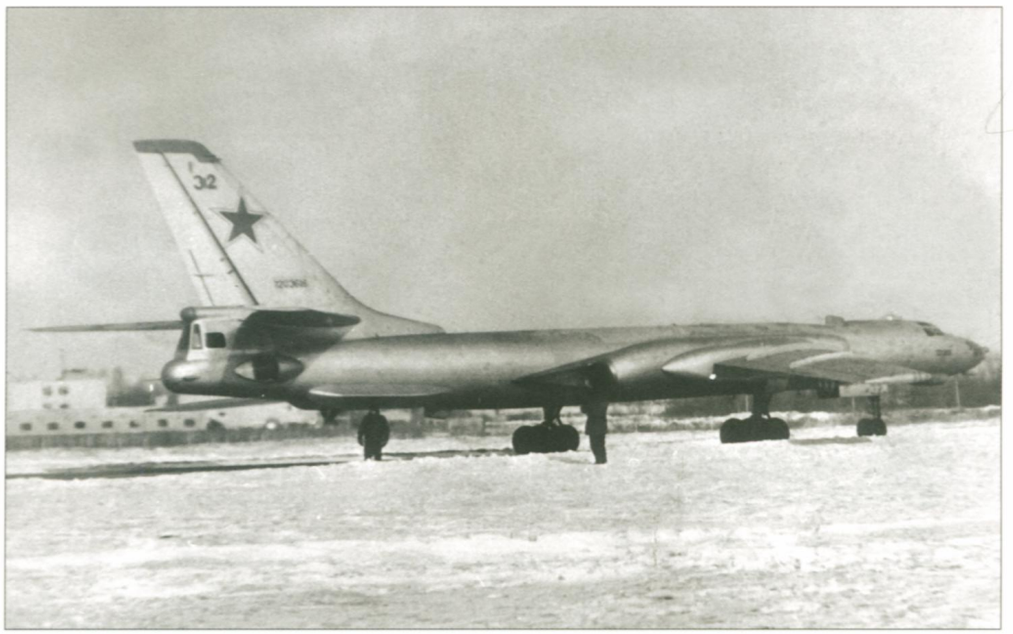
The demand for the drones was small at first, with only the Kazan' factory carrying out the modifications in parallel with series production of the supersonic Tu-22 and later Tu-22M bombers, but the early 1980s saw the *en masse* retirement of the Tu-16 and the re-equipment of the Long-Range Aviation with the Tu-22M. As the volume of conversion work grew, the drone modification job was taken on by the Air Force's aircraft overhaul plant (ARZ – ***a**viare**mont**nyy za**vod***) No 12 in Khabarovsk. The aircraft converted there still had some airframe life remaining, allowing them to be used as trainers for a while.

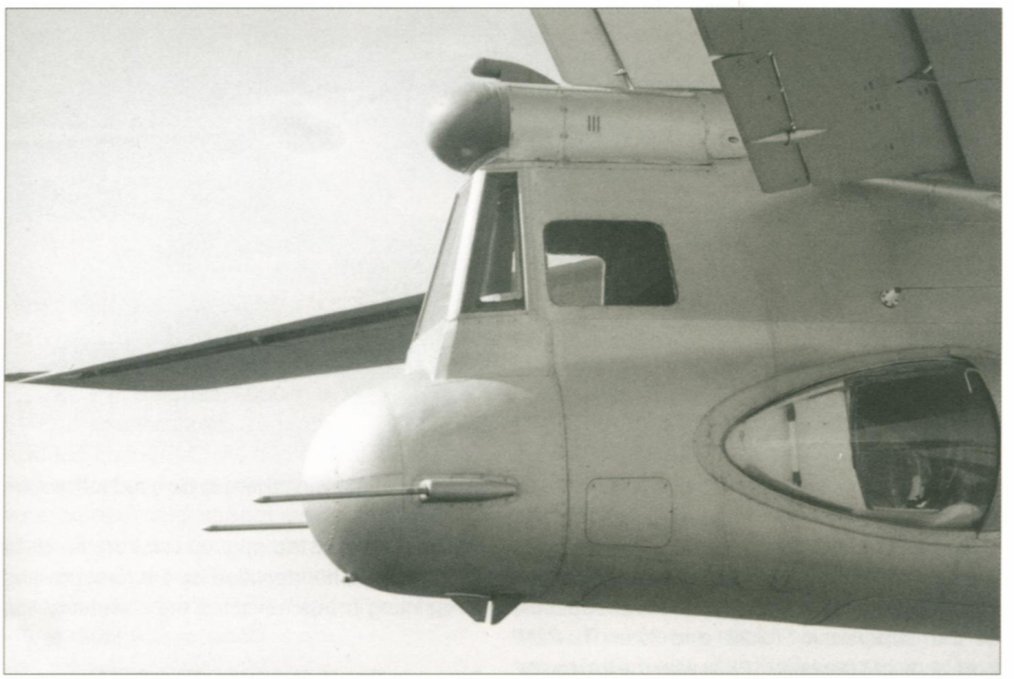
Regardless of the original version, the M-16 drones could be identified by the forward- and aft-pointing probe aerials of the command link

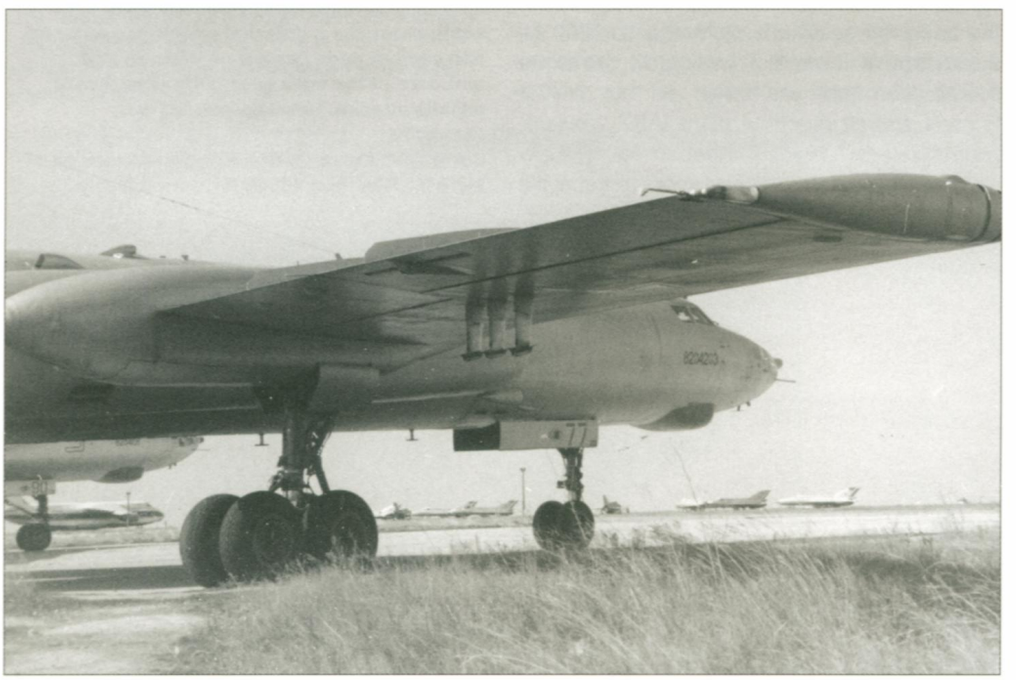
Below left: **This M-16-3 (also converted from an aircraft with individual protection ECM equipment) has a different undernose antenna and camera pods carried on V-struts just outboard of the main gear fairings to record missile attacks.** Yuriy Kabernik archive

Below right: **Close-up of the forward fuselage of M-16 '61 Red' (c/n 1882216).** Yuriy Kabernik









system on the nose and tail. Some aircraft had three tracer flares under each wingtip to facilitate visual observation from the ground during night shootdowns. The aircraft converted by the two plants had some fundamental differences; for instance, the Tu-16Ms converted in Kazan' usually had passive ECM gear, while the M-16s converted by ARZ No 12 had active jammers.

After conversion the doomed aircraft were delivered to regiments for crew training, their last flights usually taking place over a target range in Kazakhstan as targets for SAM complexes. In the early 1990s some M-16 were operated by the GK NII VVS facility at Vladimirovka AB in Akhtoobinsk, southern Russia, from where they were also finally sent to the Kazakhstan range. The Tu-16 was a tough aircraft, and at times the drone stayed in one piece and flew on even after receiving a direct hit; in this case a second missile had to be fired or a self-destruct command sent. If the missile was not fired for some reason (or missed), the aircraft could return to base and land in radio control mode.

Tu-16M (M-16) Target Drone ('order 212', 'order 2212', *izdeliye* NM)

Tu-16s converted at the Kazan' plant No 22 were initially known by the service designation Tu-16M (or *izdeliye* NM) and during production as 'order 212'. Subsequently, in common with the conversions carried out at Khabarovsk, they were called the M-16. At Kazan' most conversions were from Tu-16A bombers which had ASO-2B Avtomat-2 chaff dispensers installed in their bomb bays and were known during conversion as 'order 2212'. Later it was the turn of Tu-16E and Tu-16P ECM aircraft to be converted; missile strike versions rarely ended up this way. They were intended for use in the development of SAMs and AAMs, four flights being made with a crew on board and a fifth as a pilotless target.

'32 Red' (c/n 7203616) was converted into the one-off M-16 Orbita drone. It displays the dished fairing mounting the rear probe aerials of the radio control system which supplants the tail turret, the angular dielectric fairings replacing the dorsal and ventral turrets, and the boxy fairings low on the aft fuselage sides which house automatic chaff dispensers. Yuriy Kabernik archive

This close-up shows to advantage the typical rear end treatment of an M-16 target drone. Yefim Gordon

M-16-3 '77 Red' (c/n 8204203) pictured at Vladimirovka AB in Akhtoobinsk, the seat of GK NII VVS, is a converted Tu-16E Azaliya ECM aircraft, as revealed by the dorsal heat exchanger air intakes and outlets; so is M-16-3 '90 Red' (c/n 8204108) parked alongside. These aircraft were previously coded '90 Red' and '23 Red' respectively. Of note are the Mikoyan/Gurevich MiG-21 fighters in the background earmarked for conversion to M-21 target drones and the Antonov An-124-100 Ruslan transport of Volga Dnepr Airlines which probably delivered them to the base. Yefim Gordon

The tail of M-16-3 '77 Red' (c/n 8204203), showing the rear UKhO ECM fairing which now mounts the aft pair of radio control system probe aerials. Yefim Gordon

M-16-1 Target Drone

In Khabarovsk various versions of the Tu-16 underwent conversion into drones. Tu-16A bomber conversions with Siren' ECM sets were designated M-16-1.

M-16-2 Target Drone

Those Tu-16 drones fitted with Siren' active jammers covering the forward and rear hemispheres were designated M-16-2. These conversions were mainly carried out in Khabarovsk and based on Tu-16A bombers and Tu-16E ECM versions which had an UKhO ECM fairing.

The M-16-3 Target Drone ('order 254')

Some drones had the Siren' jammer covering only the forward hemisphere and were designated M-16-3. Various versions of the Tu-16, including those fitted with the Azaliya, Buket and Ficus ECM systems, underwent this conversion at ARZ No 12 under the terms of 'order 254'.

M-16K Target Drone ('order 254K')

Drones converted at Khabarovsk from 'glass-nosed' missile-carrying versions of the Tu-16 with forward-looking Siren' jammers, as on the M-16-3, were known as 'order 254K' during conversion and as the M-16K in service. The missile pylons were not removed.

M-16 Orbita Target Drone ('order 254 Orbita')

In 1990 a single retired Tu-16 ('32 Red', c/n 7203616) was converted into the M-16 *Orbita* (Orbit) experimental target drone (referred to during conversion as 'order 254 Orbita'). It differed from the other drone conversions in having additional antennas replacing the dorsal and ventral gun positions and boxy pods covering automatic passive ECM on the lower rear fuselage sides. This version did not pass its State trials, so no more were converted.

M-16 Target Drone ('order 285K')

An unconventional version of the target drone was developed under the aegis of the Air Defence Force and converted in 1991 under the terms of 'order 285K'. It was given a three-year service life extension and used to carry target drones until it reached the end of its service life when it became a target itself. Outwardly the aircraft could be recognised by the trapezoidal command link aerials at the wingtips. The cannon armament was retained and the crew comprised six persons.

OTHER VERSIONS AND TESTBEDS

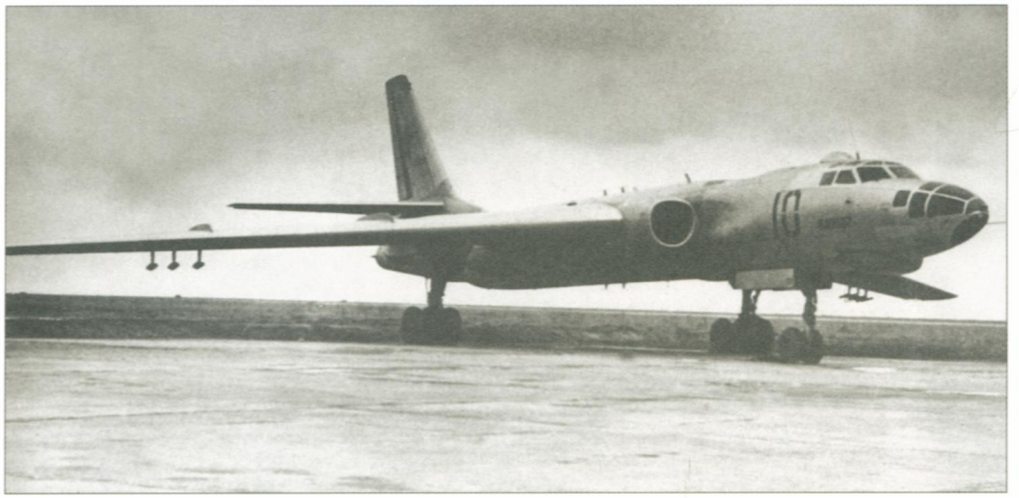
Tu-16U Bomber Trainer (project)

As the standard bomber in the Long-Range Aviation (DA) and Naval Air Arm (AVMF), the Tu-16 was also used to train aircrews. The bomber was on strength with the training regiments at the Tambov Military Pilot College, the Chelyabinsk Military Navigator College, the DA's 43rd Combat & Conversion Training Centre at Dyaghilevo AB, Ryazan', and the AVMF's 33rd Combat & Conversion Training Centre at Kool'bakino AB, Nikolayev. At first machines of the first production batches were relegated for training, but they were joined later by examples of the Tu-16A bomber and even, in small numbers, by the 'Tu-16K-something-or-other' missile-toting versions. The signing of arms limitation treaties meant that examples retired from operational service could, with armament, ECM and other miscellaneous items of equipment removed, be used for crew training as the Tu-16U (*oo**cheb**nyy* [*samo**lyot***] – trainer). Various versions of the Tu-16U bomber trainer, which was to be outwardly distinguished by a red band round the fuselage forward of the tail assembly, were planned.

The Tu-16U-1 was to be a dedicated flying training version for mastering piloting and navigation techniques, the Tu-16U-2 used for bombing training, the Tu-16U-3 for ASM launch training, while the Tu-16U-4 was to be a training version of the Tu-16K-10-26. For political reasons none of these versions actually materialised: firstly, the Tu-16 fell outside the strategic weapons category; secondly, many examples of the Tu-16 were already being converted as M-16 drones. It was decided, therefore, to combine two functions in the M-16: bomber trainer and target drone. For that reason the M-16 drones which underwent conversion in Khabarovsk had major overhauls to give them three more years of service life. This permitted them to be used as training aircraft for some considerable time. As for the training roles described above, they were assigned to the Tu-95U and Tu-95KU – decommissioned versions of the Tu-95A bomber and Tu-95K missile strike aircraft.

Tu-16 Development Aircraft with RD-3MR Engines and 'Hushkit'

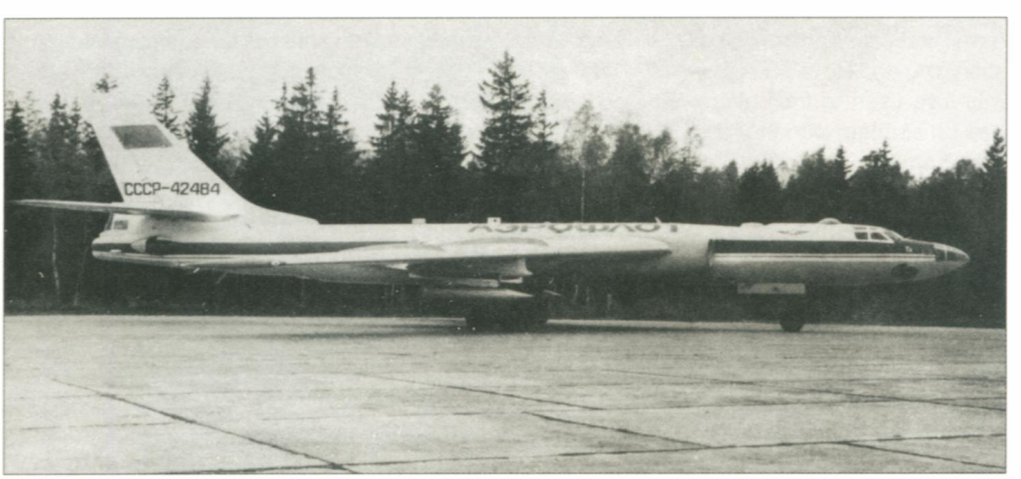
Between 1957 and 1959 the Flight Research Institute (LII) carried out ground and flight tests of Tu-16 c/n 1882808 fitted with new RD-3MR engines featuring thrust reversers (hence the R for ***rev**ers **tya**gi*). The new feature reduced the landing run by some 30-35% (from 1,500 to 950m). At the same time the engines were



prone to exhaust gas ingestion and surging, which led to the eventual abandonment of these tests. In 1961 the same Tu-16 was used to test noise-suppression engine nozzles (or, to use a commercial aviation term, a 'hushkit'). The new nozzles were not adopted, however, due to increased fuel consumption.

Tu-16KP (Tu-16RT) Airborne Command Post

In the late 1950s Semyon A Lavochkin's OKB designed a high-speed long-range cruise missile powered by a ramjet engine designed by M M Bondaryuk. Tests of the missile necessitated several command posts along the missile's flight path for controlling its flight and making whatever corrections were necessary. Airborne command posts (ABCPs) able to fly at high altitude and cover a wide radius, as well as accompanying the missile for some time, were clearly preferable to ground installations; therefore a few Tu-16s were suitably converted. The Tu-16KP (*ko**mahnd**nyy poonkt* – command post) carried the special missile control equipment in the equipment compartment and in the bomb bay, with the operator's pressurised cabin in the aft section of the bomb bay, as on the Tu-16R. These specially converted examples of the Tu-16 were stationed on normal airfields along the missile's flight path; after the missile's launch they were able to take off and track it. After Lavochkin's death in 1960 further work on the missile was discontinued and the Tu-16KPs reverted to their original form.



Tu-16 Aerial Cinematography Version

Two examples of the Tu-16K-10 were converted for filming from the air during testing and development of the in-flight refuelling system. All equipment associated with the former missile carrier role was removed and remote-controlled film cameras on special mounts replaced the dorsal and tail turrets. Both aircraft served for a long time in a number of flight test programs.

Tu-16 Weapons Testbed with a DK-20 Tail Turret

The DK-7 tail turret of a single Tu-16 was replaced by a DK-20 twin-cannon tail turret intended for the Tu-22 during evaluation flight tests.

Tu-16 Tsiklon-N Weather Research Aircraft ('order 386')

In the early 1970s a number of aircraft, including a Tu-104A, an IL-18D and two An-12BPs, were modified for use in the *Tsik**lon*** (Cyclone) programme for atmospheric research and cloud-seeding under the auspices of the Central Aerological Observatory (TsAO – *Tsen**trahl**'naya aerolo**gich**eskaya observa**tor**iya*), a division of the Soviet Union's State Committee for Hydrometeorology and Environmental Control (***Gos**komghidro**met***). On 4th April 1976 MAP issued order No 176 envisaging the conversion of several Tu-16s into Tu-16 Tsiklon-N weather research aircraft; the N referred to the basic aircraft (*izdeliye* N). The Tupolev OKB collaborated with the Naval Air Arm to procure two examples of the Tu-16K-26 (or Tu-16KSR-2-5), c/ns 6203203 and 6203208 built in Kazan' in 1956, for modification at the Navy's ARZ No 20 at Pushkin in 1977.

The Tu-16 Tsiklon-N was intended for studying the principal thermodynamic and electric parameters of the atmosphere and cloud formations, as well as for cloud-seeding in order

Though it looks like an M-16 target drone, '10 Red' (c/n 8204203) is the Tu-16RT telemetry relay aircraft used in missile test programmes. Gromov Flight Research Institute

Tu-16NM Tsiklon CCCP-42355 No 1 (formerly Tu-16N Tsiklon, c/n 6203203) sits forlorn in a remote corner of Chkalovskaya AB following its retirement from active duty. The aircraft's origins as a Tu-16KSR-2-5 with a Rubin-1M radar are patently obvious, the large teardrop radome and missile pylons being plainly visible; all armament has been removed. The Yuriy A Gagarin Space Centre's Aero L-39C Albatros trainers are lined up in the background. Yefim Gordon

A Tu-16 in 1973-standard Aeroflot livery certainly was a strange sight. CCCP-42484 (c/n 6203208), the other Tu-16N Tsiklon, differed slightly in equipment fit and colour scheme (note the angular dorsal sensor fairings). The rainmaking chemical dispenser pods carried on the pylons are probably modified stock KMGU-1 submunitions dispensers used by tactical strike aircraft and helicopters. Tupolev JSC

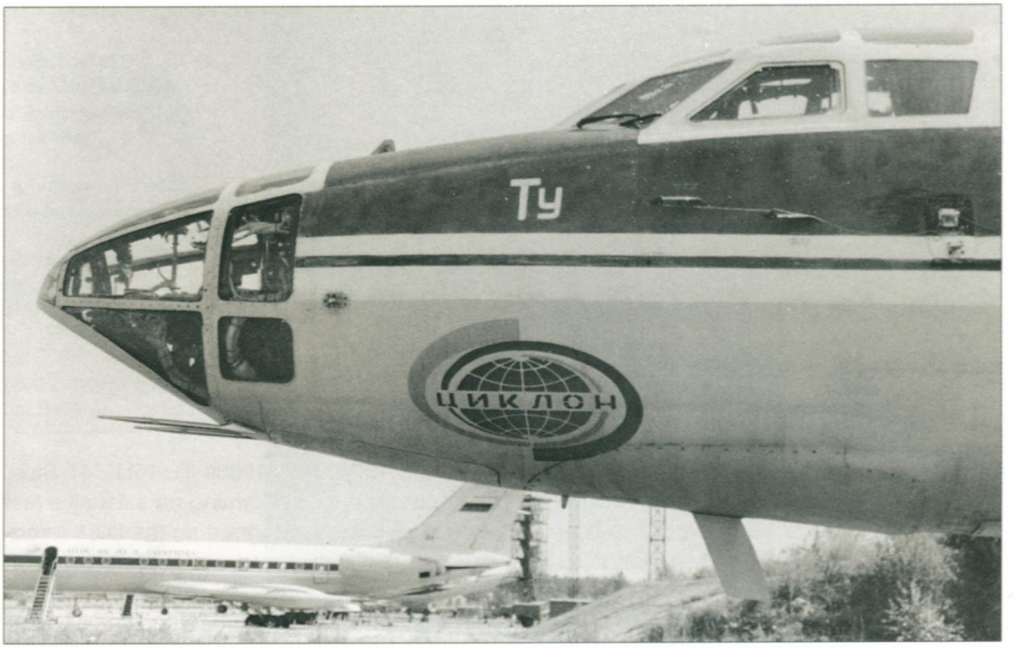
to make rain (for instance, when it was necessary to prevent an impending hailstorm which could destroy crops, or to scatter rain clouds which could ruin a public holiday). Accordingly all armament and military equipment (except for the missile pylons) was removed and replaced by R-802V and R-802GM radios, a Rubin-1M wide-scan weather radar with its antenna in a large teardrop radome under the centre fuselage and other special equipment. The former weapons bay and wing hardpoints were used for carrying special bombs filled with rainmaking chemicals (such as silver iodide) or special pods housing research equipment or chemical dispensers.

Trials by GK NII VVS and TsAO lasted from November 1978 to April 1980, whereupon both aircraft were placed on the civil register as CCCP-42355 (c/n 6203203) and CCCP-42484 (c/n 6203208). In keeping with their new mission they gained the blue/white 1973-standard Aeroflot livery – save that the type was marked on the nose simply as 'Tu'. Like the other research aircraft in the Tsiklon series, the Tu-16s (redesignated) wore the eye-catching Tsiklon emblem on the nose to clarify their 'storm chaser' role.

The two Tu-16 Tsiklon-Ns served for more than ten years in a variety of scenarios over central Russia and the Ukraine, including 'sky cleaning' missions during the 1980 Moscow Olympics and damage control in the wake of the 1986 Chernobyl' nuclear disaster.

Tu-16 Tsiklon-NM
Weather Research Aircraft

On 19th November 1986 the Soviet Council of Ministers ordered that both Tu-16 Tsiklon-N aircraft should be re-equipped to enable them to participate in international weather research programmes. Eventually only CCCP-42355 (the first aircraft to be thus registered) was so modified, beginning its tests in 1991 which were interrupted by the disintegration of the USSR that year. The Tu-16 Tsiklon-N and the Tu-16 Tsiklon-NM were to have been used for the last time during the First Chechen War in 1995-96 but they did not, in fact, take part and were retired soon afterwards. The fate of CCCP-42484 is unknown, while CCCP-42355 No 1 was last noted in reasonably good condition at Chkalovskaya AB (its home base) in August 1999. Curiously, back in late 1987 the registration CCCP-42355 was reused for a Yakovlev Yak-42 short-haul airliner (c/n 4520424711399) delivered to Aeroflot's Lithuanian Civil Aviation Directorate; thus, contrary to all rules there were *two aircraft with the same registration* operational at the same time!



Close-up of the nose of Tu-16NM Tsiklon CCCP-42355 No 1, showing the characteristic logo carried by all weather research aircraft in the Tsiklon series; curiously, the type is marked on the nose only as 'Tu'. The airliners in the background are actually Tu-134LK-2 cosmonaut trainers operated by the Yuriy A Gagarin Space Centre. Yefim Gordon

Tu-16 for Spraying Carbonic Acid

Two Tu-16N tankers were used for spraying carbonic acid in the late 1970s as part of the Tsiklon research programme. They were based at Chkalovskaya AB.

Tu-16AFS Photo Survey Aircraft

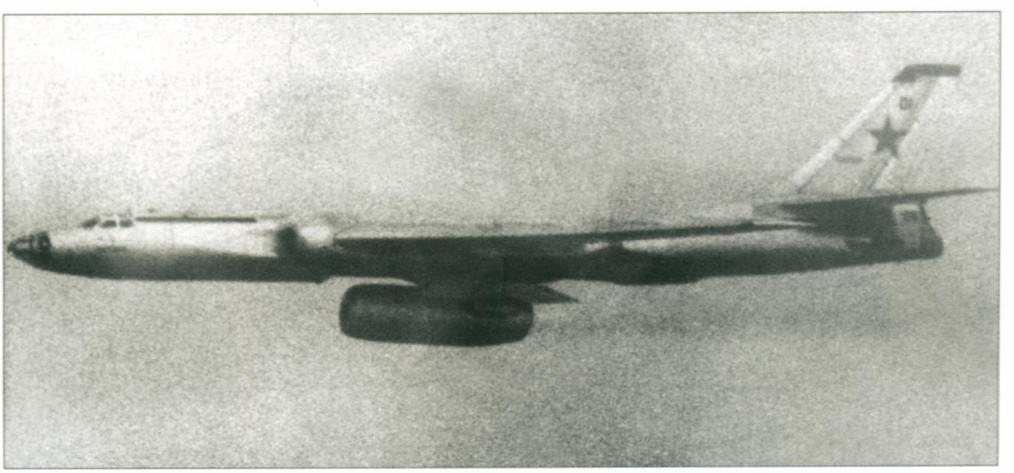
In the early 1970s a Tu-16 operated by one of the Soviet Air Force units (coded '69 Red', c/n unknown) was re-equipped to perform aerial photography along the route of the Baikal-Amur Railway. The Tu-16AFS (***aerofotos"yom****shchik* – photo survey aircraft) operated from various civilian airports, although it was 'registered' to LII and officially home-based at Zhukovskiy.

Tu-16LL Engine Testbed

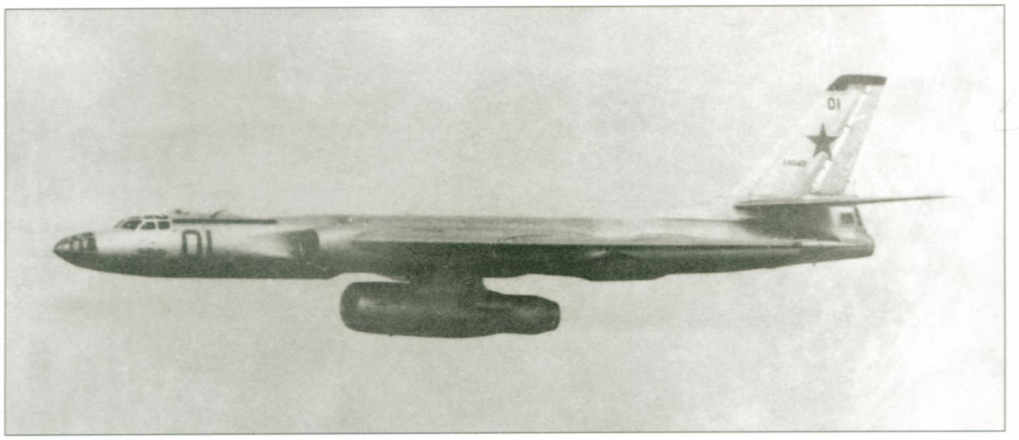
Starting in 1954, the Tu-16 was used on a wide scale for testing new jet engines, structural components, assemblies, avionics, equipment and armament. Such aircraft were usually called Tu-16LL (*le**ta**yuschchaya labora**tor**iya* – lit. 'flying laboratory'); this Russian term is used indiscriminately for any kind of testbed, research or survey aircraft.

Most often, however, the designation Tu-16LL applied to the nine engine testbeds operated by LII from Zhukovskiy. The Tu-16LLs had the radar and all armament removed and carried the test engine in a special nacelle housed in the former bomb bay. The nacelle was semi-recessed during take-off/landing to provide adequate ground clearance and extended clear of the fuselage by a special hydraulic mechanism before the test engine was started. The nacelle featured an emergency jettison mechanism (in case it failed to retract before landing or the development engine caught fire); a movable circular cover closed the air intake when the nacelle was stowed to prevent foreign object damage and stop the engine from windmilling. As a rule, test equipment heat exchangers were mounted on the upper centre fuselage or on the test engine nacelle.

The first example to be adapted for engine testing was a standard bomber (tactical code unknown, c/n 1880403) built in Kuibyshev in 1954, which was used to test the Lyul'ka AL-7F



One of the Tu-16LL engine testbeds operated by LII – presumably '01 Red' (c/n 6401501) – with a large turbofan engine (probably a Solov'yov PS-90) lowered into running position. Note the test equipment heat exchangers mounted directly on the development engine's nacelle. Gromov Flight Research Institute



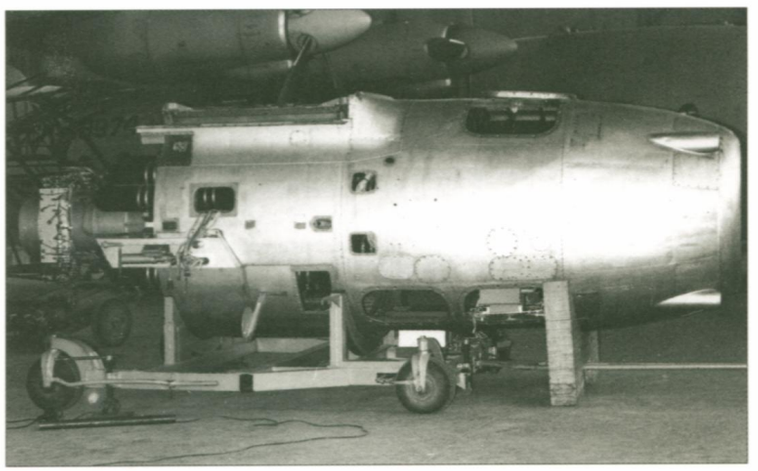
Left: **Another Tu-16LL, '01 Blue' (c/n 6401401; note the differently applied tactical code), with a very similar development engine nacelle – right down to the test equipment heat exchanger placement. In this case, however, the test engine appears to be an afterburning turbofan, which required the rear end of the nacelle to be lengthened accordingly.**
Gromov Flight Research Institute

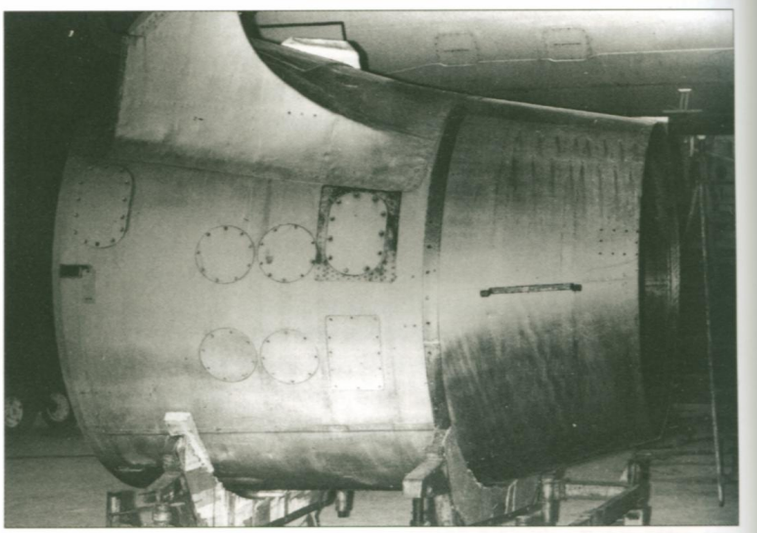
afterburning turbojet developed for the Sukhoi Su-7 fighter-bomber. The other Tu-16LLs were adapted as test beds, including Voronezh-built '01 Blue' (c/n 6401401), '03' (c/n 6401403), '08' (c/n 6401408), '41 Blue' (c/n 6401410) and '01 Red' (c/n 6401501), Kazan'-built '02 Blue' (c/n 4201002) and '05 Blue' (c/n 8204105), and Kuibyshev-built '10 Red' (c/n 1881110). Some 30 engines, including the Dobrynin VD-7 afterburning turbojet, Kuznetsov NK-8, Solov'yov D-20P and D-30 turbofans, Tumanskiy R13-300 and R15B-300 afterburning turbojets, R-27 afterburning turbofan, R27V-300 thrust-vectoring turbofan and R-29 afterburning turbofan, Lotarev D-36 turbofan, Lyul'ka AL-7 and AL-7F turbojets, Ivchenko AI-25TL turbofan, Gavrilov R-95Sh turbofan and so on – in short, nearly all Soviet second- and third-generation jet engines – were tested on these aircraft in the course of some 30 years.

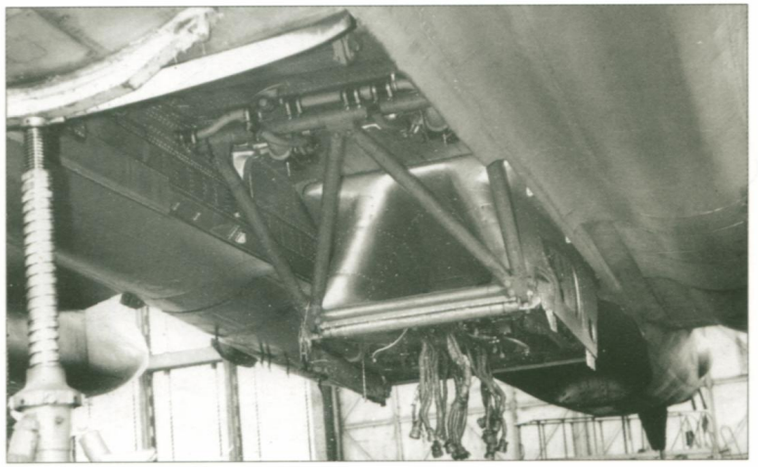
In the 1970s and 1980s Tu-16LL '41 Blue' was modified for performing an extensive test and development program on the D-36 turbofan intended for the Antonov An-72 *Coaler* short take-off and landing (STOL) light transport and the Yak-42 *Clobber* short-haul airliner; at LII this aircraft was known as the Tu-16LL-410. At this time, too, the Tu-16LL found use for testing full-size airframe assemblies together with their engines. For instance, '02 Blue' and '41 Blue' carried complete fuselages of the Yak-36M *Forger* shipboard vertical/short take-off and landing (V/STOL) attack aircraft incorporating an R27V-300 lift/cruise engine and a pair of Kolesov RD36-35V lift-jets; '10 Red' (probably called Tu-16LL-110 at LII) and '02 Blue' carried a complete fuselage of the Czech Aero L-39 Albatros advanced trainer with an AI-25TL engine, and the like. These tests enabled the effect of the air intake design on the engine's operation to be studied and engine operation at various angles of attack to be verified. As in the case of the engines alone, the aircraft assemblies were housed in the former bomb bay and lowered clear before engine starting.

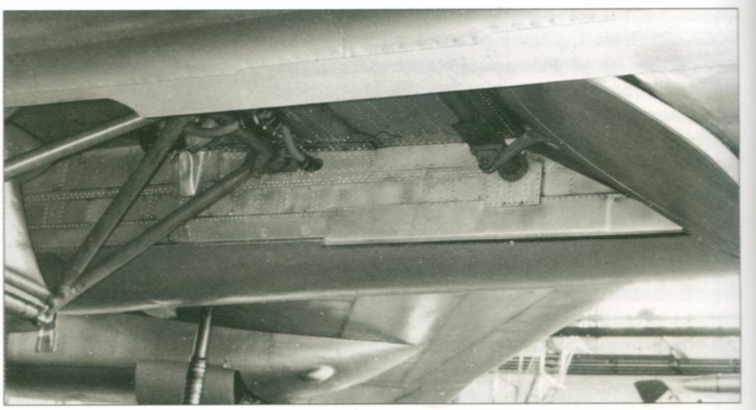
Several assorted testbeds were used during development work on the equipment and armament for the MiG-29 *Fulcrum* tactical fighter in 1976-78, including the Tu-16; an example sometimes referred to as LL-88 was used to test the Izotov RD-33 afterburning turbofan.

One Tu-16LL was lost when the test engineer mistook the glow of the setting sun on the development engine's nacelle for a fire and the entire crew baled out. Another example crashed on 1st February 1971, killing the crew of five captained by the famous test pilot Sultan Amet-Khan, Hero of the Soviet Union; the cause was erroneous elevator trim tab deflection which caused the machine to dive into the ground.









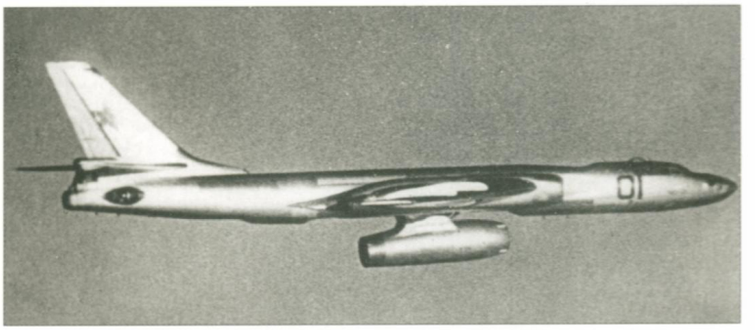
Photographs on the opposite page::

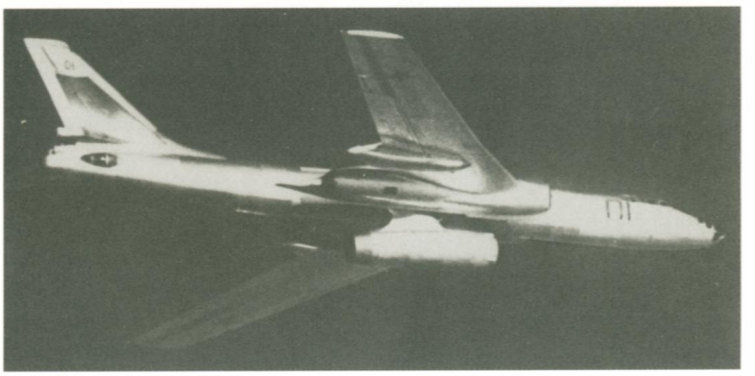
Lower left: **The detached development engine nacelle of a Tu-16LL (minus rear fairing) on a ground handling dolly in one of LII's hangars, showing the numerous access panels and cooling air intakes. An-12BK CCCP-48974 in the background is a de-icing systems testbed.**

Lower right: **The detached tail fairing of the Tu-16LL's development engine nacelle. Tu-16LL '02 Blue' (c/n 4201002) is visible in the background.**

Bottom left: **A view inside the Tu-16LL's bomb bay, looking aft, showing the special retractable pylon for the development engine nacelle and its actuation mechanism. Note also the fuel line and the many electrical connectors dangling from the bomb bay.**

Bottom right: **Another view inside the Tu-16LL's bomb bay, showing the air intake shutter in retracted position.** All Gromov Flight Research Institute





Photographs on this page:

Top and upper right: **A Tu-16LL in action, probably with a Lyul'ka AL-7F afterburning turbojet. The development engine nacelle is identical to the one in the preceding views.**

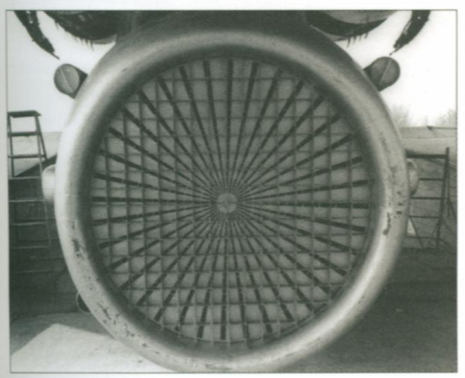
Lower right: **For ground runs and installation/removal of the development engine the Tu-16LLs had to be parked on special elevated concrete ramps to increase the ground clearance, as illustrated by '41 Blue' (c/n 6401410).**

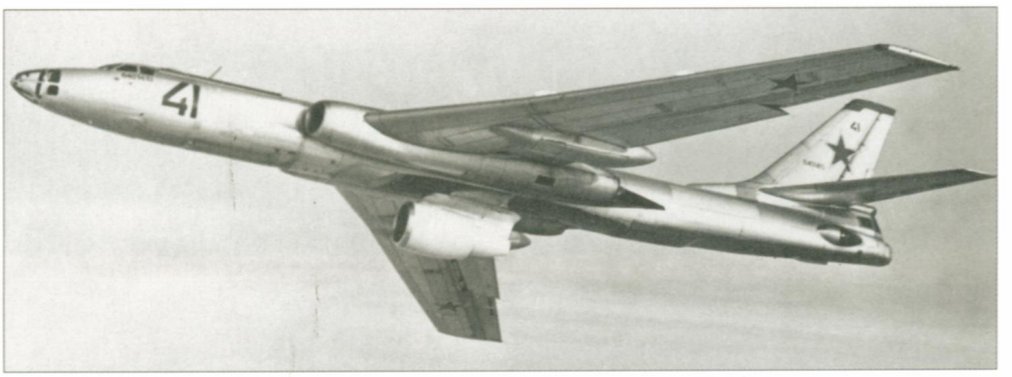
Below left: **The compressor face of a development engine installed in a fully extended nacelle. For ground runs the air intake was closed by a special foreign object damage (FOD) prevention grille.**

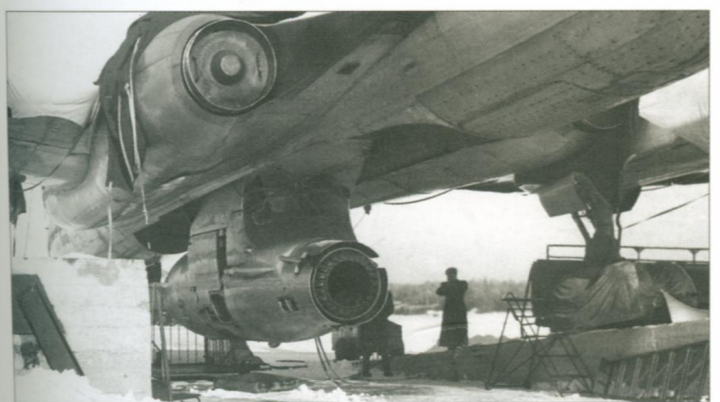
Below right: **At one stage of its career Tu-16LL '41 Blue' (c/n 6401410) was used for testing the Lotarev D-36 turbofan developed for the Yak-42 short-haul airliner, complete with a standard Yak-42 engine nacelle and pylon. This view shows clearly that the Tu-16LLs had the RBP-4 radars deleted as superfluous for their testbed role.**

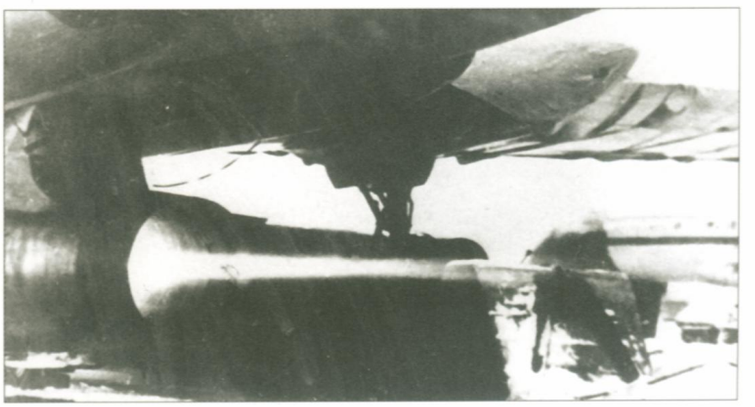
Bottom left: **A fighter engine (the convergent-divergent supersonic nozzle is clearly visible) is prepared for a ground run beneath a Tu-16LL. Note the tarpaulins covering the main gear bogies, the pan collecting any oil leaking from the test engine and the makeshift FOD prevention grille erected in front of it. Most of the access panels have been intentionally left missing to facilitate adjustments in case of need.**

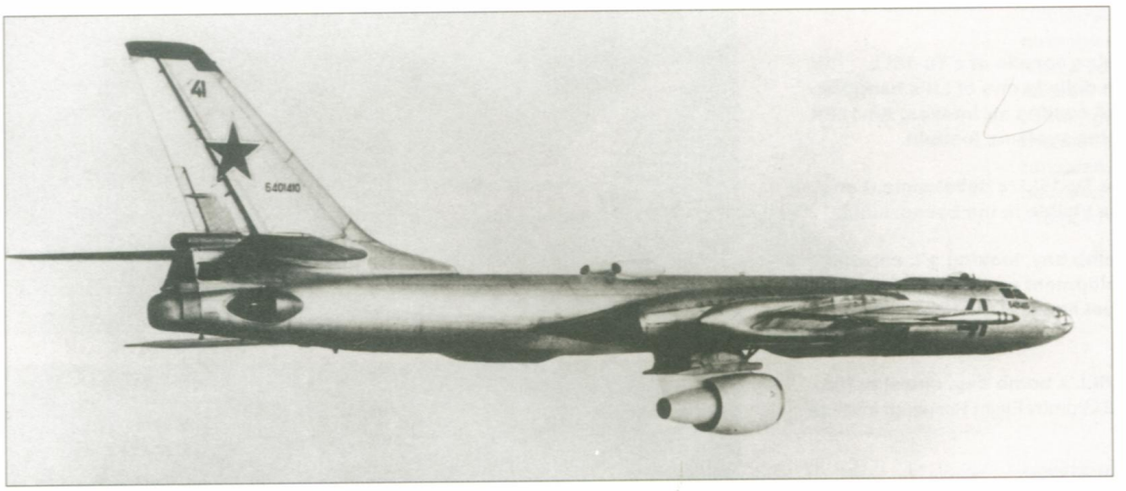
Bottom right: **A Lyul'ka AL-7F runs in full afterburner during a ground check.** All Gromov Flight Research Institute





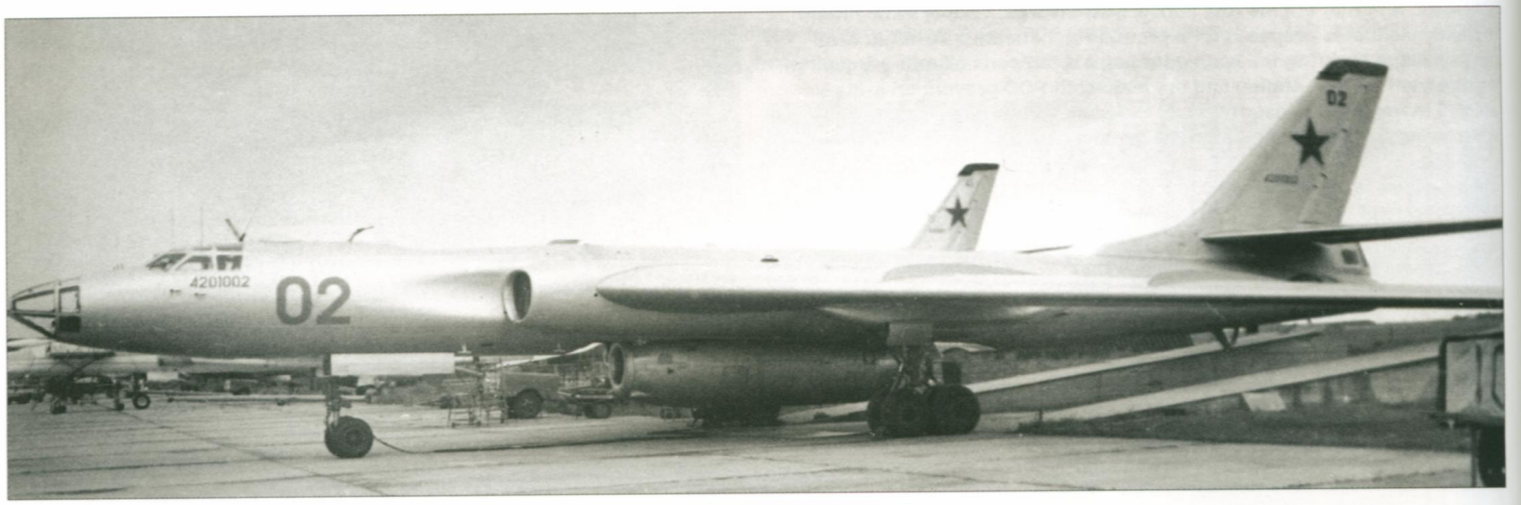




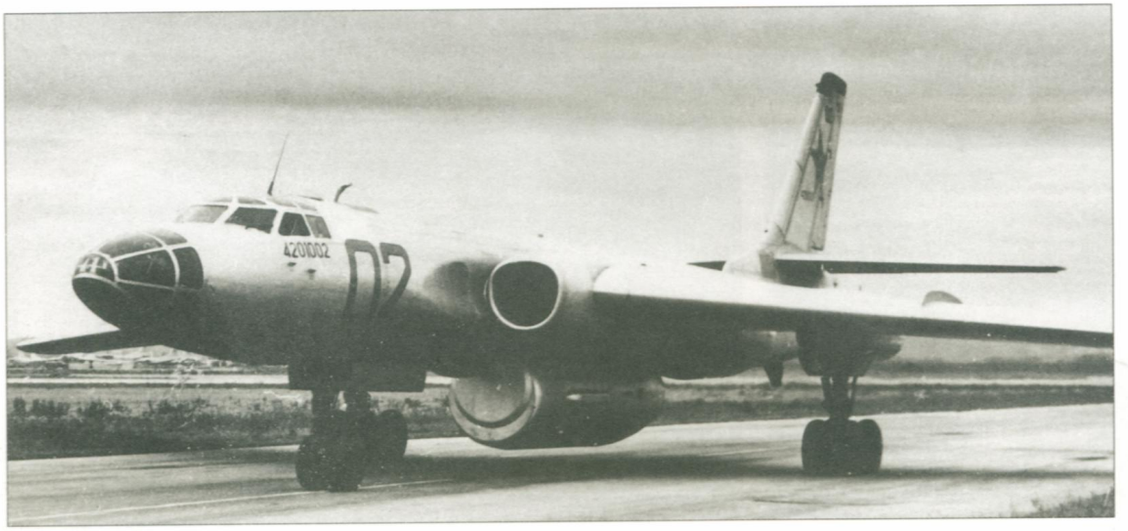


Left: **Another air-to-air of Tu-16LL '41 Blue' with the D-36 out and running. In this configuration the test equipment heat exchangers had to be installed on the upper centre fuselage.** Gromov Flight Research Institute

Below left and right: **Tu-16LL '01 Blue' (c/n 6401401) makes a low pass with an unidentified development engine in fully lowered position during the Aviation Day flypast at Zhukovskiy on 16th August 1990. LII's airfield was still off limits to the general public then, so demonstration flights were staged over specially built public grandstands on the bank of the Moskva River.** Victor Drushlyakov



Above: **Tu-16LL '02 Blue' (c/n 4201002) with a stowed development engine sits in front of one of the purpose-built ramps at Zhukovskiy in the 1990s.** Yefim Gordon archive



Left: **The same aircraft in an earlier configuration with a different test engine taxies at Zhukovskiy, the nacelle's intake firmly closed by the shutter. Note the difference in the presentation and location of the tactical code and c/n which changed in the course of an overhaul.** Yefim Gordon archive

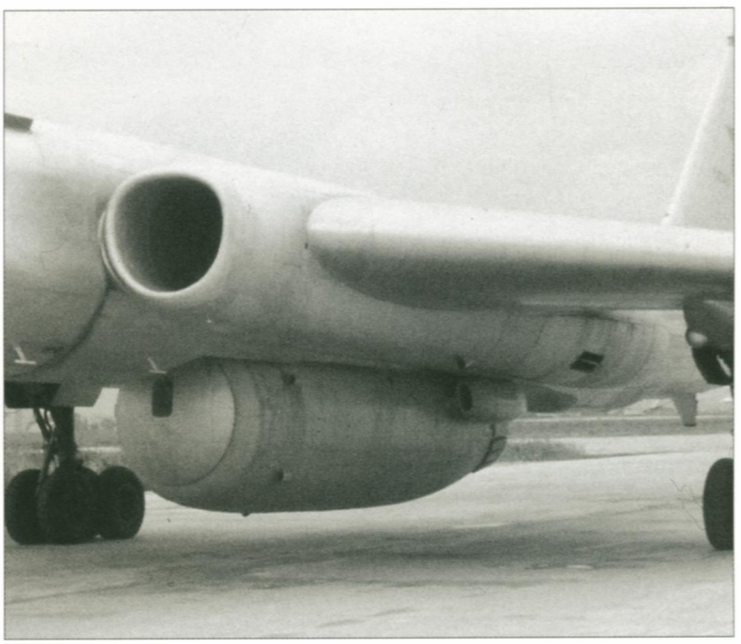
Above left and right: **Tu-16LL '01 Blue' (c/n 6401401) was part of a display staged at Zhukovskiy in May 1991 on occasion of the Flight Research Institute's 50th anniversary. Note that the design of the nacelle's intake shutter varied on individual aircraft, depending on the type of engine fitted (or, to be precise, its intake diameter). The unusually low position of the c/n on the nose is also noteworthy.** Yefim Gordon

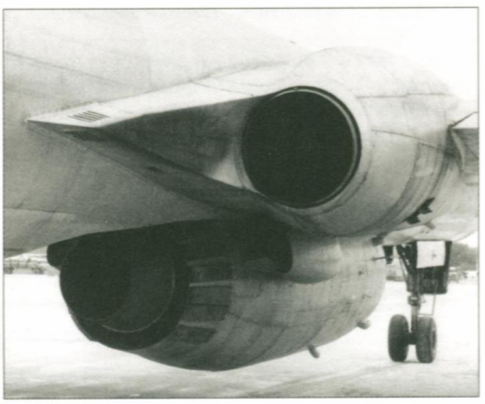
Right: **Close-up of the last engine tested on Tu-16LL '01 Blue' (c/n 6401401). As was the case with several other engines, the test equipment heat exchangers are mounted directly on the nacelle.** Yefim Gordon

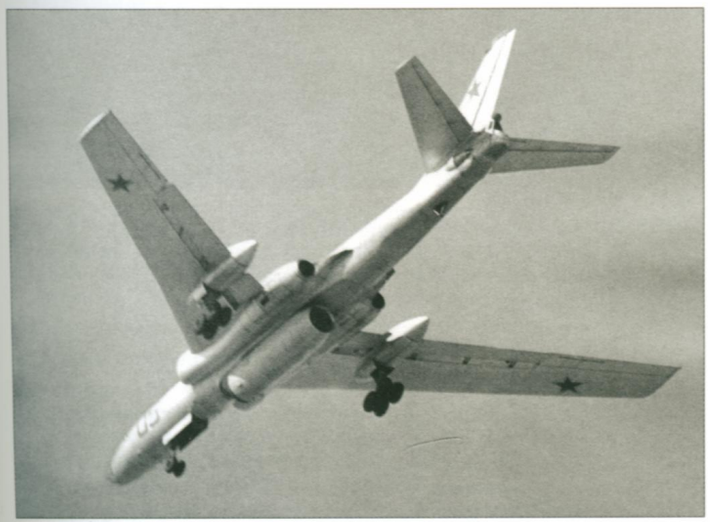
Below right: **A rear view of the same turbofan, showing the subsonic nozzle with a core/bypass flow mixer; the oblong objects at the nacelle's trailing edge are not adjustable nozzle petals! Note also the open doors of the AM-3 engine's turbostarter exhaust port.** Yefim Gordon

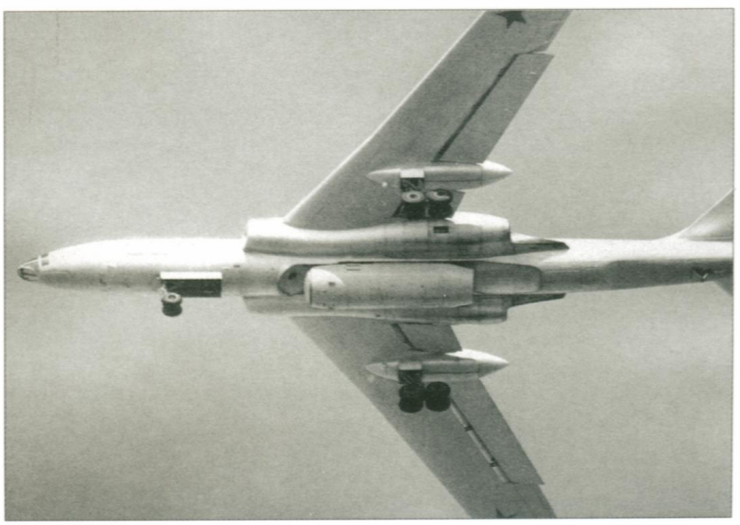
Below left: **Tu-16LL '10 Red' (c/n 1881110) sits forlorn on a rain-drenched hardstand close to LII's main hangars. With no development engine installed, the modified door-less bomb bay creating a concave lower fuselage contour is readily apparent. Note the open brake parachute bay doors.** Gromov Flight Research Institute

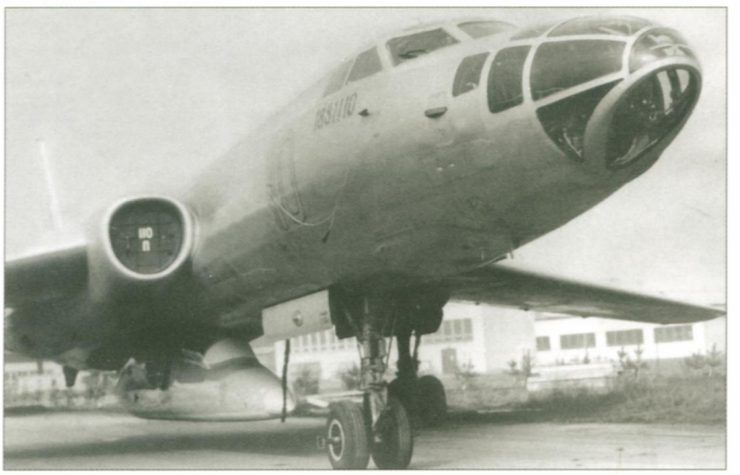
Bottom left and right: **Tu-16LL '05 Blue' (c/n 8204105) caught by the camera on short finals to runway 30 at Zhukovskiy after a test flight. Usually it was all but impossible to guess what type of development engine was installed.** Victor Drushlyakov

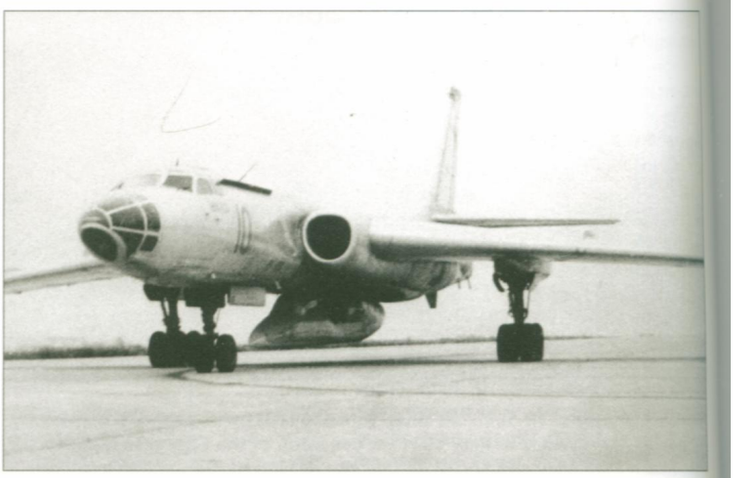


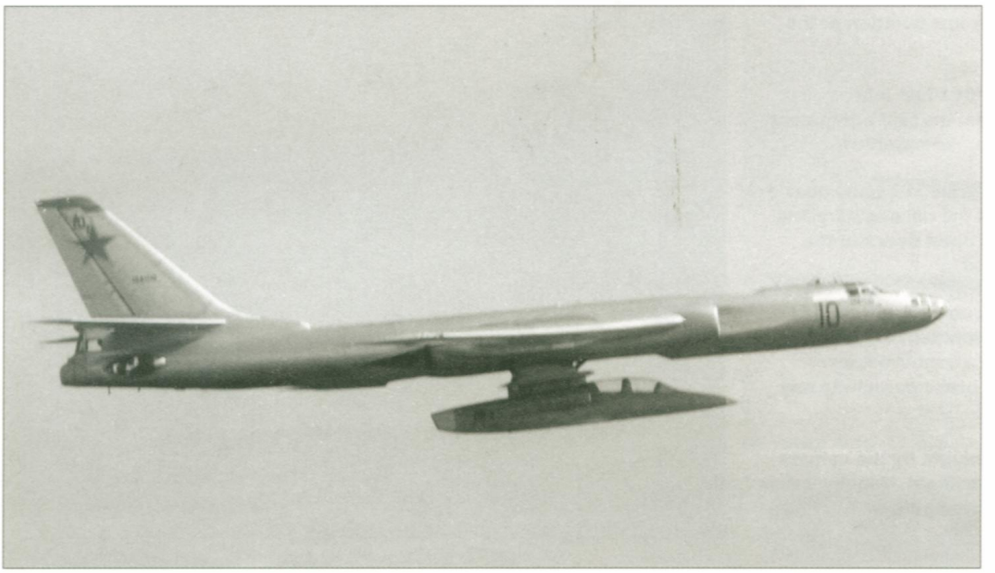








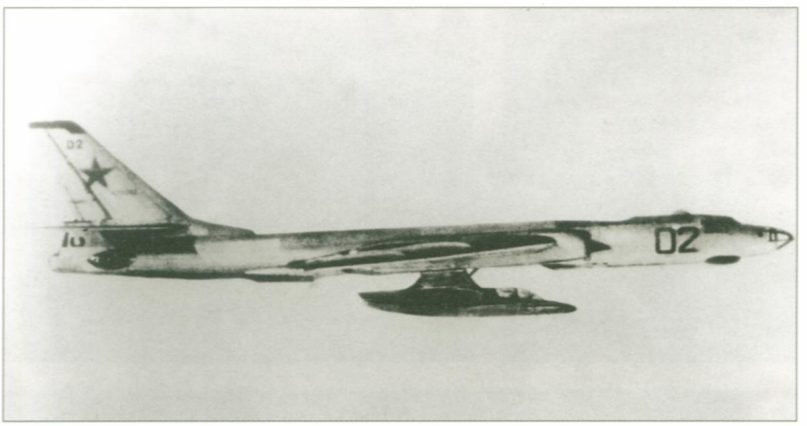




Above left and right: **Tu-16LL '10 Red' (c/n 1881110) was used for testing the Ivchenko AI-25TL turbofan – a version of the AI-25T optimised for the Aero L-39 Albatros advanced trainer. In order to accurately model the interaction between the engine and the lateral air intakes the development engine was installed in an actual full-size L-39 fuselage, seen here in semi-recessed position on the ground.** Gromov Flight Research Institute

Left: **Tu-16LL c/n 1881110 with the L-39 fuselage lowered clear of the bomb bay and the test engine running.** Gromov Flight Research Institute

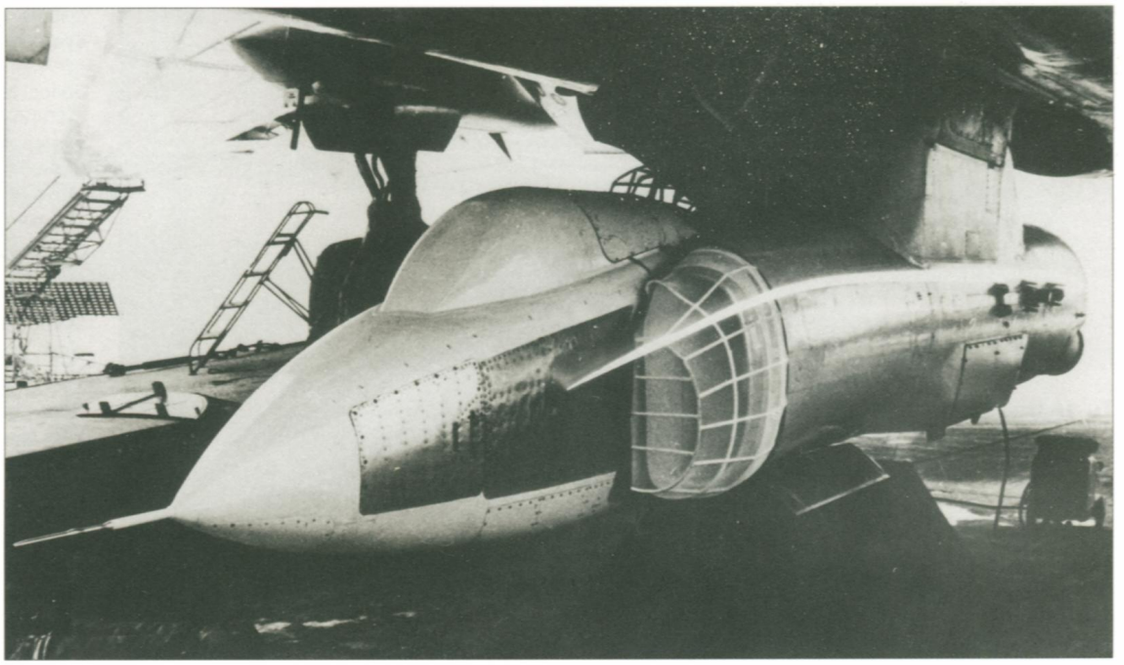
Below left: **To speed up the trials of the AI-25TL a second Tu-16LL ('02 Blue', c/n 4201002) was similarly configured with an L-39 fuselage.** Gromov Flight Research Institute



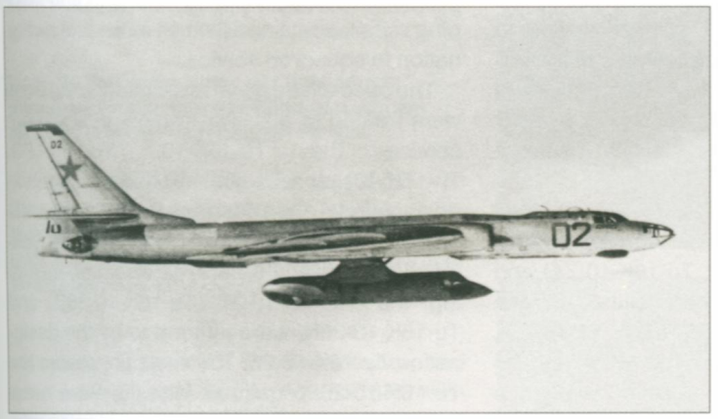
Above: **Air-to-surface missile? No indeed! The stowed L-39 fuselage on Tu-16LL '10 Red', seen here approaching Zhukovskiy's runway 30, could be easily mistaken for a large ASM.** Victor Drushlyakov

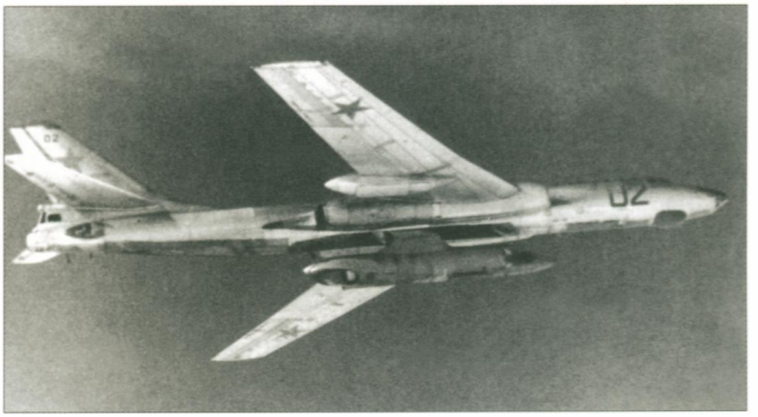
Left: **Tu-16LL '41 Blue' (c/n 6401410) had a similar configuration at one time, being used for testing the Tumanskiy R27V-300 thrust-vectoring turbojet/Kolesov RD36-35V lift-jet combination installed in a full-size fuselage of a Yakovlev Yak-36M (Yak-38) *Forger* shipboard V/STOL attack aircraft.** Gromov Flight Research Institute

Right: **Close-up of the Yak-36M fuselage lowered for ground tests of the powerplant as Tu-16LL '41 Blue' sits on the special ramps. The open dorsal air intake doors and the ventral clamshell exhaust doors for the paired RD36-35V lift-jets are just visible in this view. Note the FOD prevention wire mesh screens on the lateral intakes of the lift/cruise engine and the short ogival nosecone tipped with a pitot as incorporated on the actual first and second prototypes; this gave place to a longer conical nose on subsequent aircraft.** Gromov Flight Research Institute



Below left: **Again, due to the high priority of the Yak-36M programme a second 'wish I had wings' fuselage/powerplant combination was built and fitted to Tu-16LL '02 Blue' (c/n 4201002). The aft fuselage shape of the real Yak-36M was, of course, rather different.** Gromov Flight Research Institute





Tu-16 Avionics and Equipment Testbeds

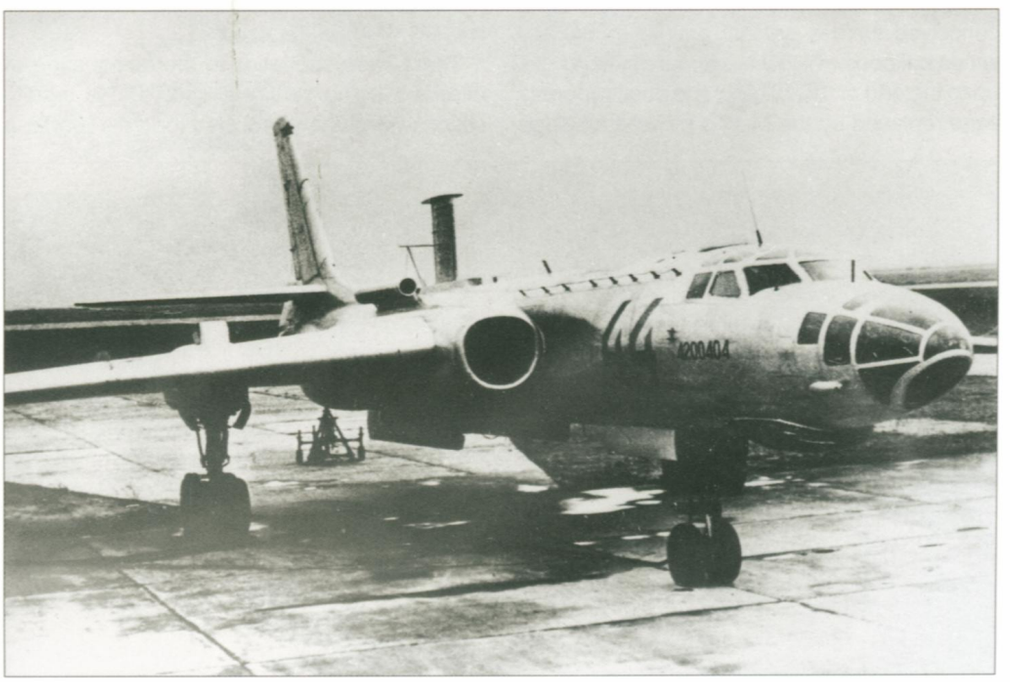
In the late 1950s and early 1960s OKB-156 modified two Tu-16s to serve as testbeds during development of the '121' cruise missile and its production derivative, the Tu-123 Yastreb (Hawk) supersonic reconnaissance drone. Both aircraft belonged to LII; one – obviously one of the Tu-16LLs listed above – served as a testbed for the drone's Tumanskiy RK-15-300 afterburning turbojet (a short-life version of the R-15-300 powering the MiG-25 fighter) and the second served for verifying the Tu-123's data link system.

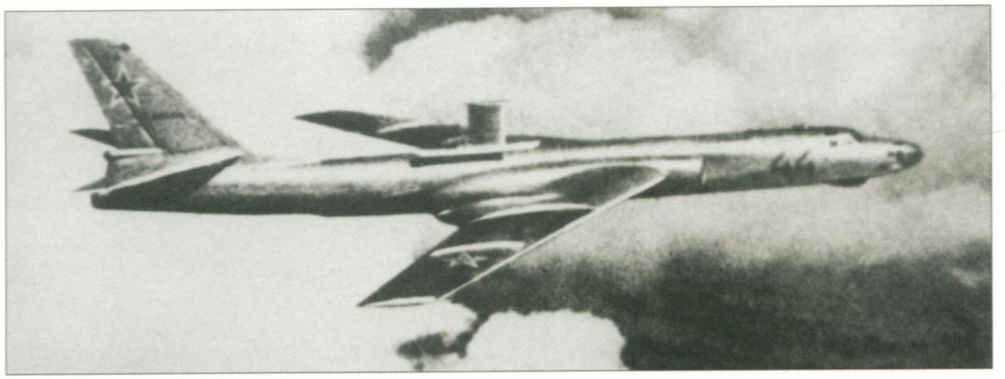
A Tu-16 coded '44 Red' (c/n 4200404) was later used for aerodynamic tests and de-icing system trials, featuring an aerofoil-shaped test article installed atop the fuselage.

The Flight Research Institute also converted the first Kuibyshev-built Tu-16 ('57 Red', later recoded '24 Red', c/n 1880101) for testing missile guidance systems. A missile seeker head in a conical metal fairing tipped by a dielectric radome was installed at the extremity of the nose (on the navigator's station glazing); to prevent the heavy assembly from breaking loose it was firmly secured to the forward fuselage structure by four sloping twin bracing struts and a horizontal beam ahead of the flightdeck windscreen. A cine camera in an egg-shaped fairing was fitted aft of the flightdeck to record the guidance system's accuracy.

Above right: **Another view of Tu-16LL '02 Blue' in 'Forgerised' configuration – probably the first in its capacity as an engine testbed; note that the standard bomb-aiming radar is still in place. Both nozzles of the R27V-300 lift/cruise engine are visible here. Note that the aft fuselage underside is sheathed in heat-resistant steel to protect the skin against the jet exhaust.** Gromov Flight Research Institute

Below: **Tu-16 '44 Red' (c/n 4200404) was converted by LII into a de-icing systems testbed with an aerofoil-shaped test article mounted dorsally on the centre fuselage. The tubular object on top of the starboard engine housing may be a heat exchanger.** Gromov Flight Research Institute





Left: **An air-to-air shot of LII's Tu-16 de-icing systems testbed.** Gromov Flight Research Institute

Bottom left and right: **Tu-16K-10(ZA) '57 Red' (c/n ...2042) was converted into the 17LL-2 targeting system/weapons testbed by the Myasishchev Experimental Machinery Factory as part of the effort to create the M-17 'balloon killer' aircraft. The weird shape of the nose is visible in these views.** Victor Drushlyakov

Tu-16 Undercarriage Testbed

In the late 1950s a single Tu-16 coded '56 Red' (c/n unknown) was adapted for ground tests of the 'jump strut' nose landing gear mechanism devised for the Myasishchev M-50 *Bounder* supersonic heavy bomber. An extensible extra twin-wheel strut was mounted immediately aft of the nose gear unit, emulating the M-50's four-wheel nose gear bogie which could be tilted to increase the angle of attack on take-off. This feature was necessary because the M-50 had a bicycle landing gear.

17LL-1 Testbed

In 1978 a modified Tu-16 (obviously again one of the aforementioned Tu-16LLs) was supplied to LII as the 17LL-1 for use in tests of the Kolesov RD36-51V turbofan scheduled for installation in the Myasishchev M-17 *Mystic-A* high-altitude aircraft. The 17LL-1 carried the engine in a special ventral nacelle which was lowered into the slipstream when test runs of the RD36-51V were carried out.

17LL-2 Testbed

A Tu-16K-10(ZA) coded '57 Red' (the c/n ends ...2042) was obtained from the Soviet Navy by the Myasishchev Experimental Machinery Factory and converted for testing the search and targeting system (STS) and gun turret developed for the M-17. (Best known as a reconnaissance and research aircraft, the M-17 was conceived for use against drifting reconnaissance balloons which were a real menace right up to the end of the 1970s.) The nose radomes were replaced by the M-17's forward fuselage incorporating sighting windows, and the standard DT-7V turret was replaced by the one developed for the high-flyer. The distinctive nose profile made the 17LL-2, as the aircraft was known, look uncannily like a saiga antelope. Live weapons trials were carried out on this aircraft, using real balloons as targets.

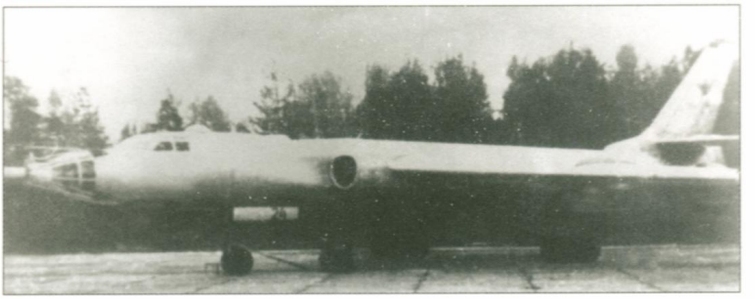
In describing the variants of the Tu-16, the differences between the various versions equipped for in-flight refuelling have not been described in detail. The distinguishing features of the IFR system have been covered in descriptions of the Tu-16 (ZA) and Tu-16K-10(ZA). In all other respects the aircraft were identical to those without IFR capability.

Initially aircraft equipped for IFR were denoted by the letters ZA in brackets: Tu-16(ZA), Tu-16A(ZA), Tu-16KS(ZA), Tu-16K-10(ZA) and so on. Later the brackets were omitted and the aircraft designated as Tu-16ZA, Tu-16AZA, Tu-16KSZA, Tu-16K-10ZA, Tu-16RZA and so on. Occasionally the letters 'za' in lower case were used in documents – Tu-16za, Tu-16Rza, Tu-16Eza and so on. Once the IFR system had become an almost standard feature of the aircraft and most Tu-16s possessed IFR capability, the letters 'ZA' were no long used and the designation reverted to its original form: Tu-16A, Tu-16E and so on. To determine whether a particular example was IFR-capable or not you needed to see its record card where the ZA suffix was retained.

There were subtleties in the designation of missile-carrying versions, and various modifications were often 'grouped together' under a common designation in Soviet Air Force service. Thus the Tu-16KSR-2, Tu-16KSR-2A and Tu-16KSR-IS were generally given the common designation Tu-16KSR-2, while both the Tu-16K-11-16 and Tu-16KSR-2-11 were referred to as the Tu-16K-11-16. The largest single grouping was the K-26 group, where the designation Tu-16K-26 might refer to a Tu-16K-26, a Tu-16K-26-07, a Tu-16K-26V, a Tu-16K-26 with a Rubin-1M radar, a Tu-16KSR-2-5, a Tu-16K-26-2-5 with a Rubin-1M radar or a Tu-16KSR-2-5-11. Only the Tu-16K-26P ASM version armed with anti-shipping missiles retained its own individual designation in squadron service.

The specialised naval missile-toting versions were treated in a similar fashion. In squadron service the Tu-16K-10, Tu-16K-10D, Tu-16K-10N and Tu-16K-10P had the common designation Tu-16K-10. Sometimes the Tu-16K-10D was given its own individual designation. Similarly K-26 ASM versions, including the Tu-16K-10-26, Tu-16K-10-26D and Tu-16K-10-26N, were referred to by the designation Tu-16K-10-26. The exceptions were the Tu-16K-10-26P equipped with the Ritsa radar homing system and KSR-5P anti-shipping missiles and the Tu-16K-10-26B, the only version of the K-10 family with bombing capability.

Sometimes the Tu-16KS was referred to by the alternative designations Tu-16KS 'E' or Tu-16KS (E), the letter 'E' indicating that the aircraft was armed with the Kometa ASM which was given the production designation '*izdeliye* E' for security reasons. For this reason a series of orders for the Tu-16 to be converted from one version to another had only letter suffixes to differentiate them – for instance, 352A and 352E, 497A and 497E, depending on the origi-

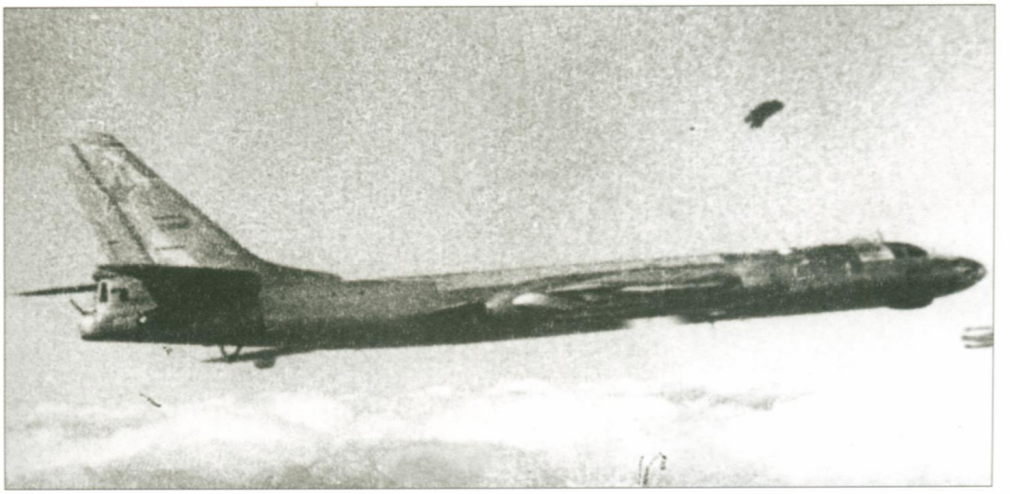


Above left: **The first Kuibyshev-built Tu-16 ('57 Red', c/n 1880101) was converted into a missile guidance systems testbed. The missile's radar seeker head installed on the nose glazing (with retaining braces) and the cine camera 'egg' aft of the flightdeck are clearly visible.** Gromov Flight Research Institute

Above right: **The same aircraft at a later date, following recoding as '24 Red'.** Gromov Flight Research Institute

Close-up of the nose of Tu-16 '24 Red' (c/n 1880101); the missile's radar seeker head has been removed, leaving only the braced mounting platform. Gromov Flight Research Institute

Tu-16 '30 Red' seen in one of LII's hangars during conversion into a testbed of unknown purpose. Gromov Flight Research Institute



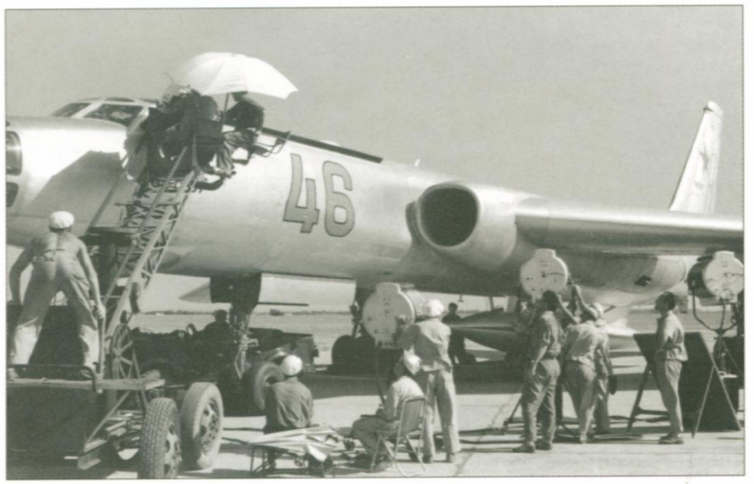
This Tu-16 was used for ejection seat tests. Here a seat with a dummy is seen leaving the flightdeck; a special hatch with a reinforcement plate around it appears to have been incorporated for this purpose. Gromov Flight Research Institute

nal version from which the modification had been made (Tu-16A bomber or Tu-16KS missile carrier). For that reason too the Tu-16KSR-2 is sometimes referred to as the Tu-16KSR-2E, and the Tu-16K-11-16 as the Tu-16K-11-16E.

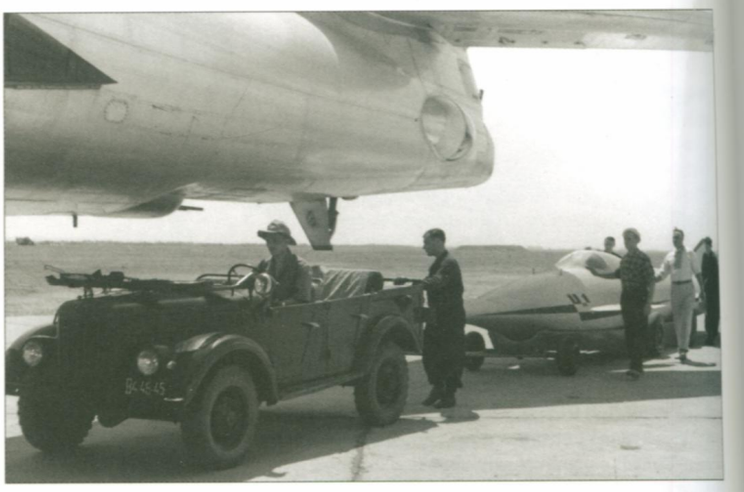
In the service manuals the Long-Range Aviation's Tu-16 missile strike versions (and sometimes the naval versions as well) are given the common designation Tu-16K (for ***kom****pleks* [*vo'oroo****zhen****iya*] – weapons system), although at the end of the 1950s an experimental version had also been given this designation.

In squadron service barely any differentiation was made between the Tu-16RE, Tu-16RR, Tu-16RM and Tu-16 'Romb' which were all referred to by the normal reconnaissance designation Tu-16R. Similarly, no differentiation was made between Tu-16 aircraft fitted with the Buket, Kaktus and Fikus ECM systems or those armed with the RPZ-59 'anti-radar' missile, and they were all frequently referred to as the Tu-16P. On the other hand, the Tu-16E was almost invariably referred to as the Yolka, although this particular designation was borne by the special Tu-16 Yolka. The Tu-16ER was referred to as a normal Tu-16E, while the Tu-16E itself in its chemical reconnaissance version was given the 'unofficial' designation Tu-16E-KhR.

In Soviet Air Force service no distinction was made between the Tu-16NN and Tu-16N tankers, which were both known by the latter



Top left: **Tu-16 '46 Red' (c/n 1881907) starred in a Soviet motion picture called *The barrier of the Unknown*, depicting a 'mother ship' for an imaginary hypersonic rocket-powered research aircraft designated Ts-1. This photo shows preparations for a static filming sequence.** Yefim Gordon archive



Bottom left: **Tu-16 '56 Red' was converted into a testbed for the 'jump strut' nose landing gear devised for the Myasishchev M-50 bomber. This view shows the telescopic second nose gear at maximum extension; note the auxiliary wheels on the tail bumper.** Gromov Flight Research Institute

Top right: **A GAZ-69A jeep tows a dolly with the partially assembled full-scale mock-up of the would-be Ts-1. The Tu-16 made high-speed taxi runs but did not fly with the Ts-1 because the mock-up was not stressed to withstand dynamic pressures.** Yefim Gordon archive

Bottom right: **Close-up of the highly modified nose gear unit of Tu-16 '56 Red'. The officer standing next to the aircraft is holding a control box for the 'jump strut' mechanism connected to the aircraft by a cable.** Gromov Flight Research Institute

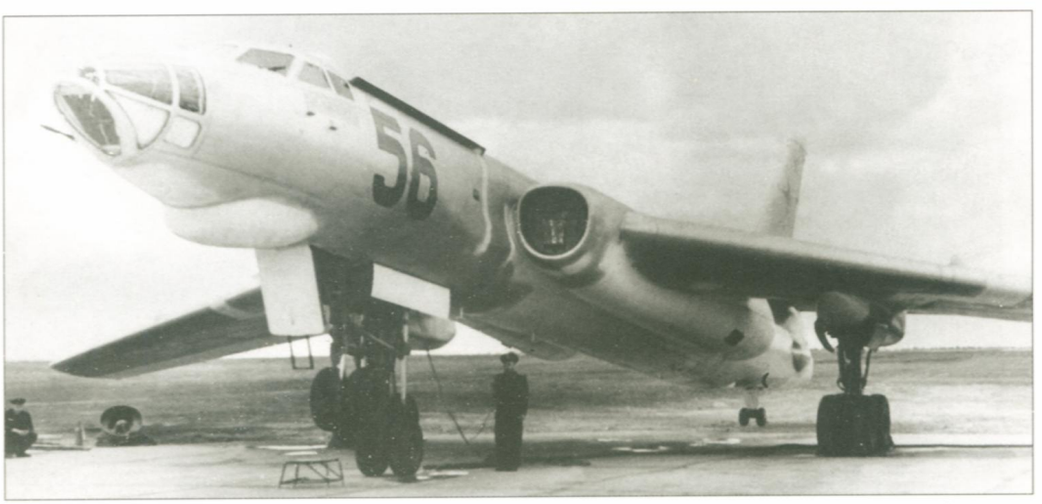
designation. Target drones were also given the common designation M-16, and Tu-16M was rarely used. The Tu-16PLO is sometimes referred to as the Tu-16PL in documents, and the Tu-16Z tanker as the Tu-16Yu.

When aircraft were refitted, special attention was given to increasing the bomb-carrying capacity (under the terms of 'order 684') and in OKB-156 such modifications were given the 'B' suffix. But even within the design bureau itself the designations Tu-16AB, Tu-16KSR-2B, Tu-16K-11-16B, Tu-16KSR-2-5B and Tu-16KSR-2-11B were hardly ever used, nor were they used by service squadrons. Even the aircraft record cards showed no change in designation, with just a note made to the effect that the machine had been modified to carry a greater bomb load. Exceptions to this were the Tu-16K-26B and Tu-16K-10-26B whose designations rarely appear in special documents. In squadron service these designations were hardly ever used.

The Tu-16 was also subject to the secrecy imposed on all Soviet military equipment in the post-war years. Almost every item of military technology had two designations: the actual one (which was classified) and an unclassified designation for everyday use in a service context. Thus Tu-16 was the actual designation, with '*izdeliye* N' as the unclassified 'cover designation'. In unclassified documents the designation Tu-16 was changed to 'N', with the version designator letters added, when led to some monstrous ciphers. Thus the Tu-16A was the 'NA' and the Tu-16R was the 'NR', which was tolerable; but the Tu-16REZA became the 'NREZA', the Tu-16KRMEZA turned into 'NKRMEZA' and the Tu-16K-10 the 'NK-10'. After declassification, the *izdeliye* designations for the Tu-16 fell into disuse.

Over its many years of service, the Tu-16 was subjected to many kinds of refits and modifications which were denoted as 'orders' followed by a series number. Since other types of aircraft underwent similar alterations, the numbering of the orders was strictly sequential. The degree of work involved in these orders varied – from replacing a certain item of equipment to a capital refit into an entirely new version. Manufacture of the aircraft at MAP factories was also implemented by order numbers. Orders for production or modification were issued by the aircraft's operators – the Soviet Air Force (VVS), the Soviet Naval Air Arm (AVMF) or the Air Defence Force (PVO).

Order '684' for the increase in bomb-carrying capacity was especially unusual in that several versions of the Tu-16 were affected. Some versions merely had their capabilities as bombers enhanced, while others assumed a bombing capability they had not had before. Refits under the terms of 'order 684' began in 1972 and involved aircraft previously modified in accordance with 'order 657'. Aircraft which had hitherto lacked bomber capability could be affected by both orders. These orders brought no change in the aircraft's designation. Only the Tu-16K-11-16 was redesignated Tu-16K-26B when it was equipped with the K-26 ASM and received an increased bomb load. Similar work was carried out in the Naval Air Arm when the Tu-16K-10-26 was modified to carry bombs. Originally these machines lacked bombing capability and were redesignated Tu-16K-10-26B after modification.



Structural Description

The following description relates to the production bomber version of the Tu-16 ('order 882', *izdeliye* N) built in the mid-1950s, and unaffected by subsequent bulletins concerning the aircraft's systems, armament and equipment.

The Tu-16 was a high-speed long-range jet bomber (or, in the light of its many modifications, a multi-role long-range jet aircraft) designed to carry out heavy bombing raids on strategic enemy targets. It could operate singly or as part of a formation, in all weather conditions by day or night. It was equipped with the requisite means for navigation, radio communications and radar, possessed a formidable defensive cannon armament, was able to carry out reconnaissance and support missions, and capable of striking enemy surface vessels.

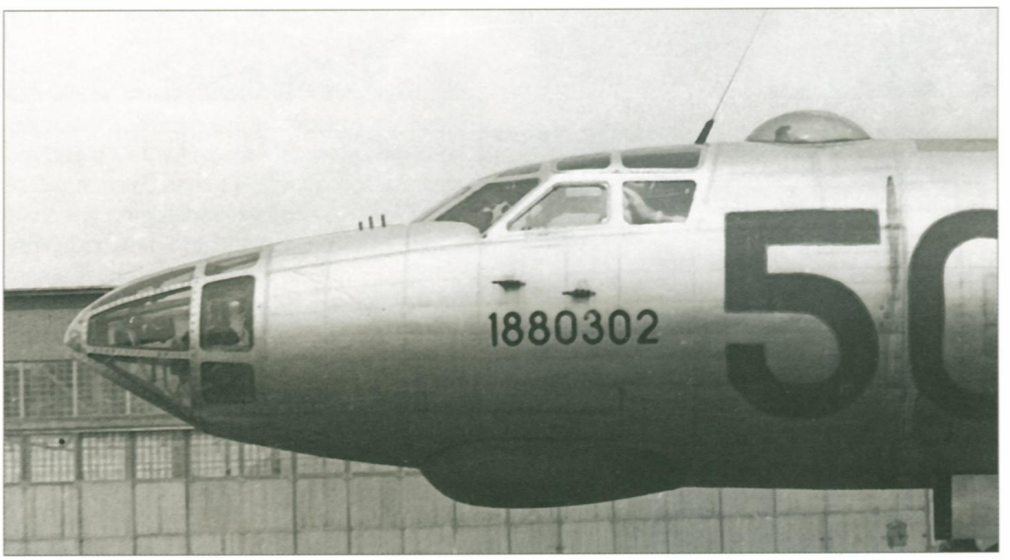
To improve aerodynamic characteristics at high subsonic speeds, the swept wings were made up of special high-speed airfoil sections with a small thickness/chord ratio. The engines were situated in close proximity to the fuselage and the wing/fuselage/engine housing junction was designed in accordance with the area rule, as were the wing-mounted main undercarriage fairings, which allowed drag to be minimised.

The aircraft's low drag combined with the comparatively high degree of lift provided by the wings accounted for the Tu-16's high aerodynamic qualities (the maximum lift/drag ratio was 16.5 at an indicated airspeed of 350-400km/h with an angle of attack of 5-6°). With the undercarriage down and flaps set at 35°, the L/D ratio was approximately 7.

All of the aircraft's essential equipment, armament and crew were accommodated in the fuselage, which was divided into sections along its length, with forward and aft pressurised cabins to house the six crew members.

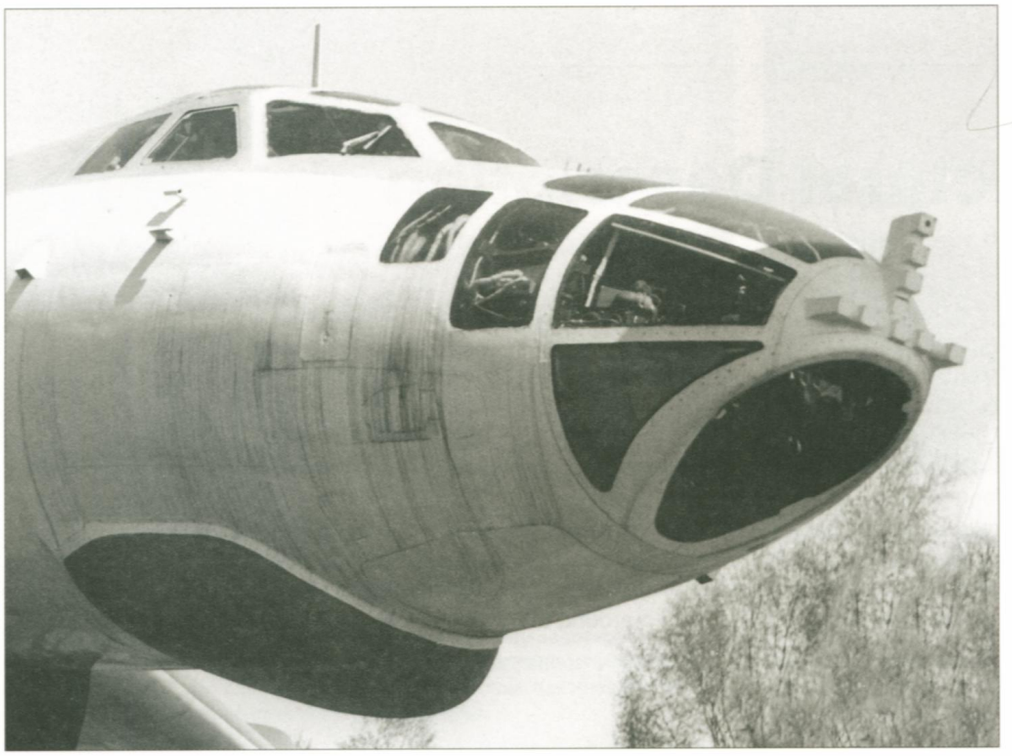
Fuselage

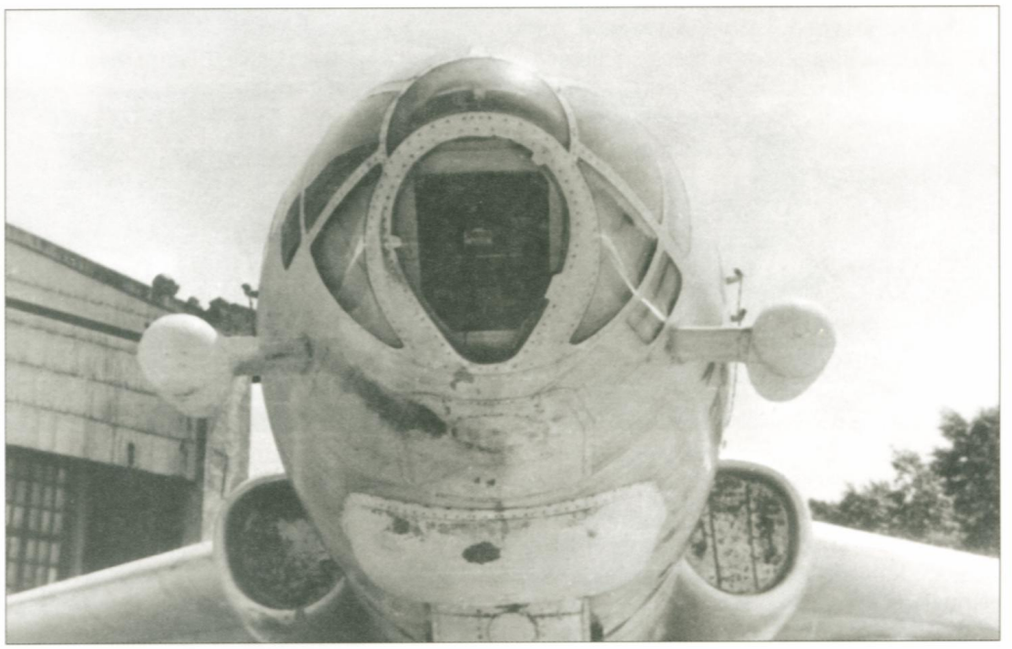
Monocoque all-metal structure of basically circular cross-section with a smooth stressed skin supported by frames and stringers made of pressed and formed components. Fuselage length 34.6m, fuselage diameter 2.5m, fineness ratio 13.9. The fuselage featured 75 frames set at intervals of 260-570mm; the cylindrical portion of the fuselage was located between frames Nos 12 and 46. The stringers were placed around the fuselage circumference at 10° intervals; auxiliary stringers were used in some places to reinforce the skin in the gaps between the basic stringers. The overall number of basic stringers in the forward section of the fuselage was 36, with fewer in the aft section. Where the structure was weakened by cutouts, extra transverse and longitudinal reinforcing beams were provided to absorb the loads from the structure's load-bearing elements, equipment and armament.

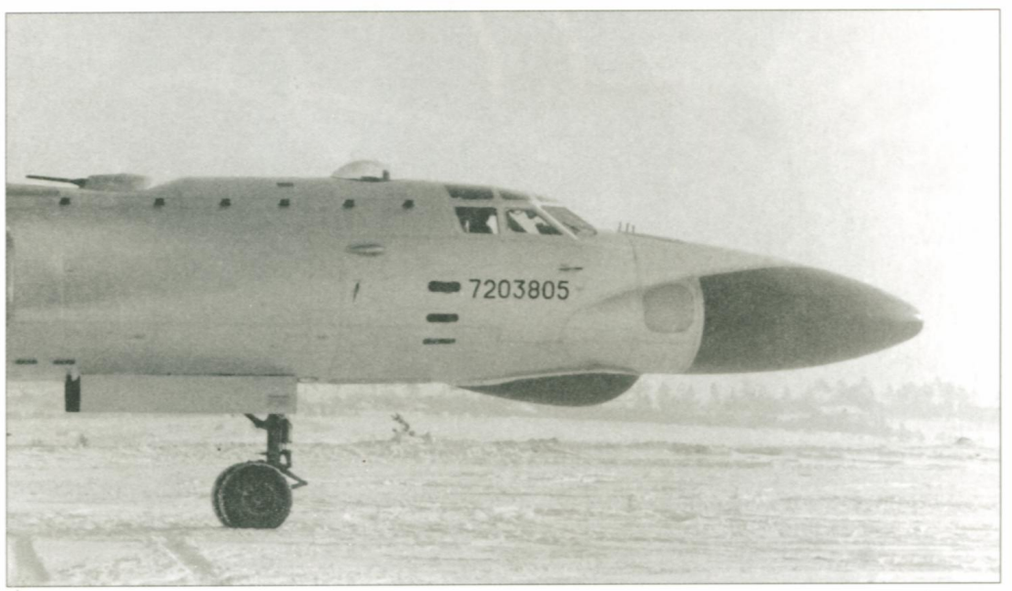


Above right: **The forward fuselage of a typical 'glass-nosed' Tu-16, showing the navigator's station glazing and the chin radome of the RBP-4 radar. Note the dorsal observation/gun-aiming blister and the triple rod aerials of the SRO-2M Khrom (NATO *Odd Rods*) IFF transponder.** Yefim Gordon

Right: **Another perspective of the forward fuselage (this time a Tu-16KS), showing the navigator's ventral ejection hatch, the entry hatch aft of the radome, and the fixed forward-firing cannon on the starboard side.** Yefim Gordon archive







The fuselage skin was made of D16ATV and D16ATNV duralumin and their varieties; skin thickness was 1-2mm, increasing to 3mm in the most highly stressed areas. The frames and stringers were also made of these materials, from MA8 magnesium alloys also being used. The navigator's station glazing frame, the entry hatch and ventral escape hatch covers, the frames of these hatches and the framework of the tail gunner's station glazing were made of ML5 magnesium alloy and its varieties, and some non-load-bearing parts of the fuselage were made of sheet magnesium alloy.

The surface of the skin was electrochemically coated and its sheets butt-jointed. The skin was secured to the framework by flush rivets or, in highly stressed locations (round the gun barbettes), by brazier-head rivets; button-head rivets were used in zones not subjected to the airflow. Double-row rivet joints were used throughout. The fuselage was assembled in five sections:

- section F-1 (the navigator's station glazing framework)
- section F-2 (the forward fuselage between frames Nos 2 and 12)
- section F-3 (the centre fuselage between frames Nos 12 and 26 – the so-called forward section);
- section F-4 (the unpressurised aft fuselage between frames Nos 26 and 69 – the so-called aft section)
- section F-6 (the aft extremity of the fuselage between frames Nos 69 and 75 which mounted the tail barbette).

For some obscure reason there was no section F-5

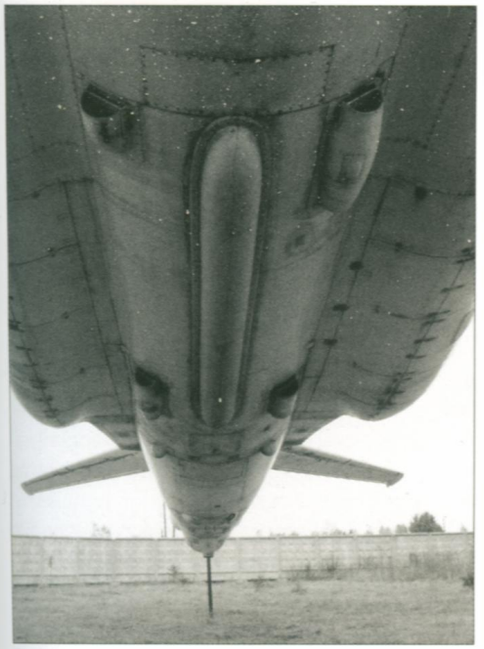
All sections were assembled on separate jigs and joined together in the plane of the following fuselage frames: F-1 with F-2 at frame No 2, F-2 with F-3 at frame No 12 (a pressure dome), F-3 with F-4 at frame No 26 and F-4 with F-6 at frame No 69.

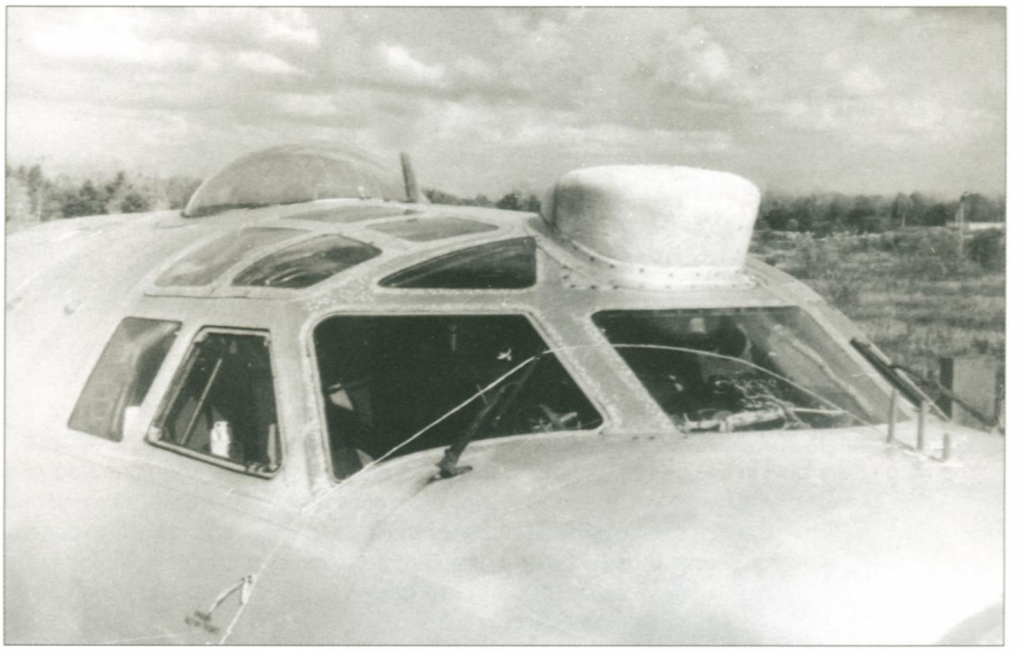
The pressurised cabin in the nose formed by sections F-1/F-2 accommodated the navigator, captain (crew commander), co-pilot and the weapons systems operator ('navigator-operator', in Russian terminology) who operated the RBP-4 bomb-aiming radar and controlled the dorsal gun barbette. The aft pressurised cabin

The nose of a Tu-16K-11-16, showing the antenna array of the Ritsa radar homing system on the navigator's station glazing and the lack of the forward-firing cannon whose position is blanked off. Yefim Gordon

The nose of a Tu-16KRME target drone carrier ('08', c/n 1883704) featuring lateral radio control system antenna pods. Note the shape of the optically flat window. Yuriy Kabernik archive

The nose of the Tu-16K-10 is extensively modified to accommodate the twin antennas of the YeS target illumination/missile guidance radar. Tupolev JSC





(section F-6) accommodated the radio operator/gunner (working the ventral gun barbette) and the defensive fire commander who operated the tail gun barbette and the PRS-1 Argon gun ranging radar. Access to the forward cabin was via a ventral hatchway under the WSO's position and to the rear crew cabin via a ventral hatchway under the defensive fire commander's seat. If the aircraft had to put down on water or make a belly landing, the crew could escape from the forward cabin through a hatch in the glazing, and from the aft cabin through an emergency exit in the tail gunner's station glazing. The aircraft would remain afloat long enough to enable the crew to take to their dinghies. Each crewmember was supplied with a personal first-aid kit, a thermos flask, in-flight rations, an emergency radio and emergency rations.

Under the forward pressure cabin was a compartment for the RBP-4's antenna closed by a dielectric fairing. Immediately behind this was the nosewheel well closed by two doors; above it was the No 1 fuel tank. The nosewheel well gave access to the DC batteries and the forward equipment bay which housed the AFA-33M aerial camera, the dorsal gun position, the KPZh-30 liquid oxygen converter for the forward cabin, the AC generator and other equipment. Above the compartment was the container for the LAS-5M dinghy for the aircrew in the forward cabin. Further back was fuel tank No 2, the wing centre section with the No 3 fuel tank, beneath which the No 4 fuel tank was located. The weapons bay closed by two doors was situated immediately aft of the wing centre section and went back as far as the Nos 5 and 6 fuel tanks. Under the No 5 fuel tank was a compartment for illumination and signalling flare bombs, also closed by twin doors. Aft of the tanks came the rear equipment bay housing the ventral gun barbette, the KPZh-30 LOX converter and dinghy container for the aft cabin crew and other equipment. The Argon radar was positioned above the aft cabin.

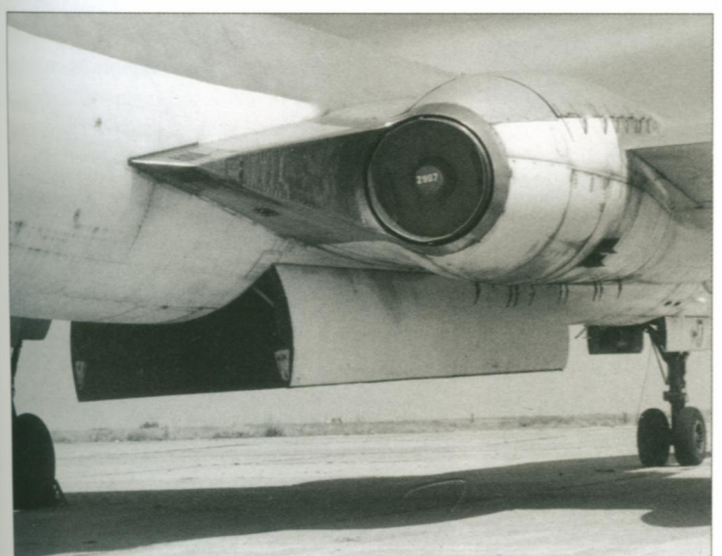
The brake parachutes were to reduce the landing run and were deployed when landing on a waterlogged or short runway, an unpaved airstrip, after an incorrectly executed landing approach or in the case of brake failure. The parachutes were housed in a detachable container in the lower rear fuselage. The PT-16

Top left: **The centre fuselage underside of the Tu-16P Buket ECM aircraft, showing the centrally mounted canoe fairing of the emitter antenna flanked by three heat exchangers and a cooling air intake.** Yefim Gordon

Top right: **The flightdeck canopy, showing the jettisonable upper sections for ejection, the sliding direct vision windows and the dorsal ECM antenna fairing (a mid-life update). Note that the dorsal observation/gun-aiming blister is built into an escape hatch.** Yuriy Kabernik archive

Bottom left: **The centre fuselage of Tu-16 '17 Red' (c/n 5202907), showing the open bomb bay doors, the rear portion of the starboard engine nacelle and the nacelle/fuselage fairing.** Yefim Gordon

Bottom right: **On some special mission variants, including this... um... masculine-looking version (probably an ECM aircraft of some sort), the bomb bay doors are non-functional. Note that the engine nacelle/fuselage fairing is skinned in heat-resistant steel.** Yefim Gordon



brake-parachute system gave a landing run of no more than 1,535m on a dry concrete runway with automatic wheel braking applied and the parachutes opened after touching down at a speed no higher than 270km/h, at a landing weight no greater than 47,000kg.

Wings

Cantilever mid-set wings swept back 35° at quarter-chord (leading edge sweep is 37° from root to rib No 7 and 36° along the remainder of the span). Anhedral 3°, incidence 1°, aspect ratio 6.627, taper 2.416; wing span 32.98m, wing area 164.65m². The mean aerodynamic chord (MAC) is 5.021m.

The wings were built in five pieces: the centre section built integrally with the fuselage, inner (first) and outer (second) detachable sections. The centre section is joined to the inner wing sections along the fuselage sides, the outer wing sections being mated to the inner ones at rib No 7; the engine housings were built integrally with the inner wings. The wings were made of D16T, D16AT and D16ATNV duralumin, AK-6, AK-8 and V95 aluminium alloy; flush riveting was used throughout.

The wings were of all-metal two-spar construction. The central portion (the torsion box) is made up of panels with thick skinning reinforced by stringers. From the fuselage out to rib No 12 the torsion box structure is utilised to accommodate flexible fuel tanks. The leading edge of the inner and outer wings and the wingtip fairings were detachable. The wings were made up of different aerofoil sections (the aerofoil varied along the span). A TsAGI PR-S-10S-9 symmetrical section with a thickness/chord ratio of 15.7% was used at the roots, a TsAGI SR-11-12 aerofoil with a thickness/chord ratio of 15% at rib No 7 and a TsAGI SR-11-12 aerofoil with a thickness/chord ratio of 12% at the tips.

The trailing edge section of the wings was occupied along the entire span by flaps and ailerons. The slotted Fowler flaps were built in two sections located inboard and outboard of the main landing gear fairings; flap settings were 20° for take-off and 35° for landing. The one-piece ailerons were of single-spar construction and carried on five brackets each, featuring internal overhand balances for aerodynamic compensation; each aileron incorporated a trim tab.

The centre section was the central part of the wing located between fuselage frames Nos.26 and 33. The inner detachable wing sections were attached to it. The centre section was a load-bearing box structure and consisted of a front and rear spar, two connecting ribs and one centreline rib, and upper and lower skin panels. The centre section skin was smooth and composed of aluminium alloy sheets 3-5mm thick.

Tail Unit

Conventional cantilever swept tail surfaces, utilising symmetrical aerofoil sections. The tail assembly was made of duralumin, except for the attachment fittings and bolts (which were mostly made of steel) and the wooden fairing at the top of the fin. All duralumin parts were electrochemically coated, the steel parts primed, and the wooden part coated with VIAM-B3 bonding agent to prevent decay.

The vertical tail was a two-spar structure with an area of 23.305m²; sweepback at quarter-chord 42°, leading-edge sweep 46°. The fin was attached to fuselage frames Nos 64 and 69 by bolts at four points (two points at each frame). A smooth fin/fuselage joint was provided by a fillet attached by screws. The one-piece rudder of single-spar construction was hinged on three brackets and a lower support, featuring aerodynamic balancing and a trim tab. Maximum rudder deflection was ±25°.

The horizontal tail of similar two-spar design had a span of 11.75m and an area of 34.452m²; sweepback at quarter-chord 42°, leading-edge sweep 45°, no dihedral. The tailplanes were likewise attached to fuselage frames Nos 64 and 69 by bolts at four points (two points at each frame). Tailplane incidence was –1.5° and could be adjusted on the ground between 0° and –2.5° at 0.5° increments, using the holes in the attachment fittings on the fuselage. The smooth tailplane/fuselage junction was effected by a fillet which was attached by screws to the lower stabiliser skin and to the side of the fuselage.

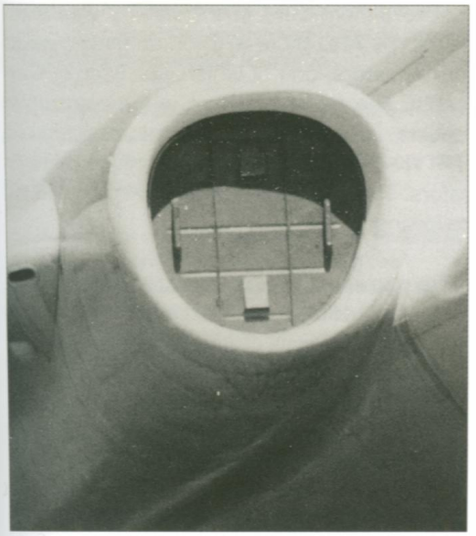
The one-piece elevators were of single-spar construction and connected on the centreline by a shaft with a universal joint ensuring simultaneous deflection. Each elevator was carried on five brackets and incorporated a trim tab. Maximum deflection angles were 12° down and 26° up.

Landing Gear

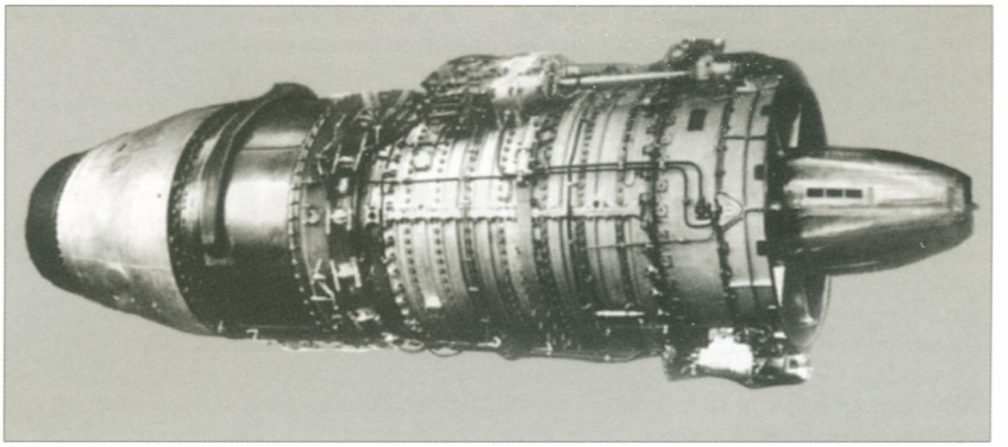
Hydraulically retractable tricycle type; all three units retracted aft. Wheel track 9.775m, wheelbase 10.913m. All three units had oleo-pneumatic shock absorbers and scissor links.

The nose unit had twin 900 x 275mm non-braking wheels and a shimmy damper; it was steerable through ±40° for taxying. The main units featured four-wheel bogies equipped with KT-16, KT-16/2, KT-16/2M, KT-16/2U or KT-16/2D brake wheels, all measuring 1,100 x 330mm. During retraction they are rotated aft through 180° by separate hydraulic rams/rocking dampers to lie inverted in the streamlined fairings protruding beyond the wing trailing edge.

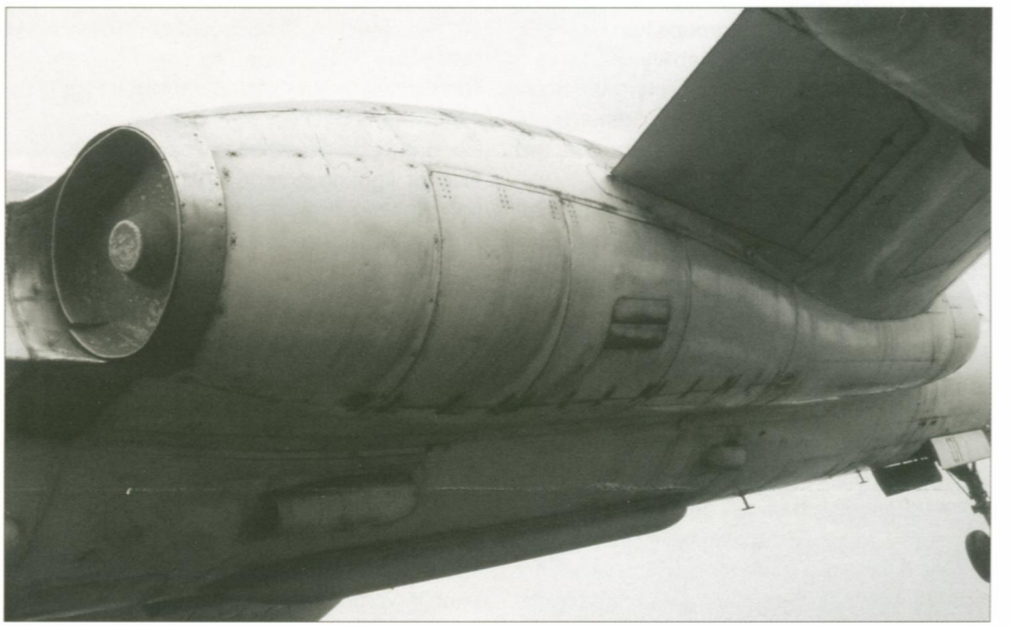
A retractable tail bumper protected the aft fuselage in the event of overrotation or a tail-down landing; it was extended and retracted by an electrical mechanism simultaneously with gear retraction/extension.



Above left: **The Tu-16's air intakes have a characteristic shape resembling a triangle with bulged sides and rounded corners. Note the concave fuselage side where the fuselage is area-ruled at the wing/nacelle/fuselage joint.** Yefim Gordon



Above right: **The Mikulin AM-3 turbojet. The long intake centrebody houses an S-300M turbostarter (note exhaust port). Two of the three accessory gearboxes are visible here.** Yefim Gordon archive



Right: **This view accentuates the Tu-16's area-ruled engine nacelles. The turbostarter exhaust doors are closed, as they are in flight.** Yefim Gordon

Powerplant

Two Mikulin AM-3 (RD-3) turbojets with a take-off thrust of 8,750kg or two RD-3M turbojets with a take-off thrust of 9,500kg (later replaced by RD-3M-500s or RD-3M-500As with an increased time between overhauls and better reliability). Specific fuel consumption (SFC) at cruise power 0.97kg/kgp·hr; engine pressure ratio 6.4 at maximum power/7.2 at contingency rating. Length overall 5.38m, casing diameter 1.4m, dry weight 3,100kg.

The AM-3 (RD-3) was an axial-flow non-afterburning turbojet with a fixed-area subsonic air intake, an eight-stage compressor, an annular combustion chamber with 14 flame tubes, a two-stage turbine and a fixed-area subsonic nozzle. Three accessory gearboxes (left, right and lower) were provided. Starting was by means of an S300M turbostarter – a small gas turbine engine housed in the air intake centrebody and driving the spool directly via a clutch (the term 'jet fuel starter' is not applicable, since the S300M ran on aviation gasoline); there were four igniters.

The engines and their accessories were located on either side of the fuselage behind the rear wing spar in housings immediately adjacent to the fuselage, which were 'squeezed' into the centre fuselage sides to minimise the cross-section area in accordance with the area rule. The rear sections of the engine housings served as a protection, safeguarding the fuselage from the effect of exhaust gases emerging at high temperatures. The housing consisted of forward and centre sections, cowling and exhaust section. The engine air intakes were located well forward of the wing leading edge, the air being fed to the engines via long ducts which were divided by a partition into upper and lower ducts routed around the wing spar; these merged again aft of the rear spar at the engines' compressor faces. Part of the air was diverted for cooling the engine accessories and the engine housings proper, subsequently being ejected together with the engine efflux.

There were separate lubrication systems for the engines and the turbostarters; the engines featured an engine control system and the required engine monitoring instruments.

Most aircraft left the factories with RD-3M engines, which were replaced later in squadron service by its later RD-3M-500 and RD-3M-500A derivatives. Eventually all Tu-16s remaining in service were fitted with RD-3M-500 engines.

Fuel System

The Tu-16 used two types of fuel: a primary fuel (T-1 or TS-1 kerosene) and a starter fuel for the engines' turbostarters (B-70 aviation gasoline). The aircraft had, therefore, two fuel systems. The primary fuel system consisted of two separate subsystems, one for each engine. If necessary, both systems could be connected via a cross-feed valve. The system had electronic automatic controls ensuring a strictly set sequence of fuel consumption and measuring the fuel quantity. Provision was made for in-flight refuelling of the aircraft's fuselage tanks and for emergency fuel jettisoning.

The fuel was carried in 27 flexible rubber tanks making up ten groups (five for each engine). Within each group the tanks were interconnected and formed one large fuel resource. Each group had a supply tank from which the fuel was drawn. At the normal all-up

Opposite left: **The fin incorporates flush antennas for the short-range radio navigation system and has a wooden tip fairing. On aircraft intended to operate in a nuclear environment the undersides and the rudder are painted gloss white. '18 Red' (c/n 1883701) at Akhtoobinsk is a Tu-16 Yolka ECM aircraft.** Yefim Gordon

Opposite right: **The rear fuselage and tail unit of the Tu-16R-2 reconnaissance aircraft, showing the tail gunner's station and the characteristic lateral observation/sighting blisters of the defensive fire commander's station. The dark panel immediately ahead of the port stabiliser is the cover of a rescue dinghy bay.** Yefim Gordon

weight of 72,000kg the maximum fuel load comprised 34,360kg (equals 41,400 litres of T-1 or 43,750 litres of TS-1). The full fuel capacity of the aircraft was 43,800 litres. The tanks belonging to the 1st, 2nd, 3rd, 4th and 5th groups were located in the fuselage, two tanks of the 6th group in the wing centre section; the tanks of the 7th,8th, 9th, 10th and 11th groups were housed in the detachable inner wing torsion boxes, while the tanks of the 12th, 13th, 14th, 15th and 16th group were accommodated in the outer wing section. Each group of tanks had a single filler cap; during ground refuelling, each group of tanks had to be filled separately. The supply tank in each group had a ETsN-T electric booster pump, but the supply tanks for the 2nd and 5th groups had two such pumps to ensure greater reliability.

A vent system for the fuel tanks was incorporated. Provision was made for emergency fuel jettisoning from the tanks of the 1st, 3rd and 4th groups.

All fuel tanks (apart from the tanks of the 1st, 2nd and 5th groups, the fuel from which was consumed first) were self-sealing. An inert gas pressurisation system using carbon dioxide was provided to minimise the risk of fire and explosion if hit by enemy fire.

Electrical System

Two electrical supply circuits. Main 28-28.5 V DC power was supplied by four of 18-kW GSR-18000 engine-driven generators working in parallel to power a common circuit, each engine driving two generators. Each generator worked with a RUG-82 carbon voltage regulator, a DMR-500 differential minimum relay and a BS-1800 ballast resistor (the latter maintained the voltage of the generator, protected it against reverse currents and ensured operation in parallel with the other generator). Backup DC power was provided by two 12SAM-53 or 12SAM-55 storage batteries.

Ground power supply was provided via a RAP or ShRA-400LK connector on the port side located at frame No 16. The operation of the electric power sources was monitored with the aid of four type A-3 ammeters, a type A-2 (A-1) ammeter and a switchable V-1 voltmeter.

115V/400Hz single-phase AC power was provided by two type PO-4500 converters, each of which worked with a R-25V carbon voltage regulator and an RS-4M rheostat. One converter was used while the other was a back-up; these operational modes were switched periodically with the aim of equally sharing the wear on the carbon brushes and the converters' service life. Control was exercised through a VF-150 voltmeter.

In addition to the main power sources, there were various autonomous system and sub-unit sources of electrical supply to provide the required power for the control, navigation and communications systems. These were type PAG-1F, PT-125Ts (later PT-200Ts) three-phase AC converters, MA-1 (later PO-500) single-phase AC converters and U-500 and RU-11AM dynamotors/converters .

As a safety measure, the DC supply was delivered through three circuits:

- a normal circuit which could draw on all four generators in any combination and the DC batteries
- an emergency circuit which drew on only one generator and one DC battery
- a dual circuit which automatically switched itself over either to the normal or emergency supply.

The circuit wiring was mainly BPVL and MGShV copper single-strand wire and BPVLA aluminium wire. To reduce radio interference, part of the copper wiring was screened (BPVLE) or enclosed in a screened sheath.

The interior lighting equipment comprised PS-45 and PSM-51 overhead lights, KLSRK-45 light fittings, ARUFOSh-45 ultra-violet lights for the instrument panels to make the dials glow in the dark and PL-10-36 movable lamps. The exterior lighting comprised BANO-45 navigation lights on the wingtips, a KhS-39 (or KhS-57) tail navigation light in the lower part of the tail fairing, LFSV-45 or FRS-200 landing lights in the lower part of the fuselage at frame No 13, FR-100 taxying lights fitted to the nose gear strut, PSSO-45 formation/anti-collision lights on the starboard nosewheel well door and the centre fuselage upper surface and an SMF-1 light for illuminating the tanker's fuel transfer hose during night contacts.

Pressurisation & Air Conditioning System

The Tu-16 had the following equipment enabling high-altitude operation:

- a system for heating the pressure cabins using engine bleed air
- a ventilation system providing fresh air from the outside at low altitudes
- systems for pressurising the entry and escape hatches with compressed air, using rubber seals in the hatch frames

Air for warming the pressure cabins was bled from the seventh compressor stage of both engines via a TKhU-128 cooling turbine. The maximum permissible flow of air through each of the two cabins was 500m^3 per hour. The quantity of air supplied to the two cabins from both engines was 2,000m^3 per hour, which allowed the system to work using only one engine.

At low altitudes the cabin ventilation system provided fresh air up to an altitude of 2,000m. It was mainly used in hot weather when the cabin temperature on the ground could be anywhere between +20 and +40°C. The air for the forward cabin was induced through an air intake on the starboard side of the fuselage at frame No 13, and for the rear cabin through an intake in the front of the fin.

The pressurisation system relied on rubber seals between the hatch covers and hatch frames. The cabins themselves were pressurised with compressed air from the onboard pneumatic system.

The air pressure in the cabins was maintained by ARD-54 or ARD-50 automatic valves or regulators, one of which was fitted in each cabin. The air temperature in the pressurised cabins was maintained automatically by TRTVK-45 (TRTVK-45M) air temperature regulators. The pressurisation system provided the following:

- from an altitude of 7,250m and above a constant pressure differential of 0.4kg/cm^2
- on entering a zone of anti-aircraft fire or combat with enemy fighters, the pressure differential was reduced to 0.2kg/cm^2 by either KKD (manual) or ARD-54 (automatic) valves in order to avoid a sudden drop in the cabin pressure when the aircraft's skin was pierced.

In the event that the ARD-54 valves were out of action in both cabins, pressure could be maintained using the KKD manual valves, allowing the pressure differential to be maintained at 0.05-0.43kg/cm^2. The cabins' temperature could be automatically regulated within set limits between +15.5 and +26.5°C or manually between +10 and +30°C.

Oxygen Equipment

The Tu-16 was the first Soviet aircraft to carry oxygen in liquid form which was then converted to gaseous form. The use of liquid oxygen (LOX) achieved a weight and volume saving six or seven times greater than that obtained with gaseous oxygen.

The oxygen equipment was provided to allow flying at high altitudes and ensure survival after ejection in an emergency. The oxygen equipment therefore belonged to two categories: that supplied to the crew stations and that forming part of the rescue equipment. The crew station oxygen was administered by the use of oxygen masks in normal flight conditions. It consisted of two KPZh-30 LOX containers, six KP-24 breathing apparatus (KP-16 on early production aircraft) with KM-24 masks, as well as fixtures, manometers and charging connectors.

The emergency equipment was for use when ejecting from the aircraft at high altitudes. Each crewmember had a KP-23 parachute unit as part of his PLK-45 parachute pack.

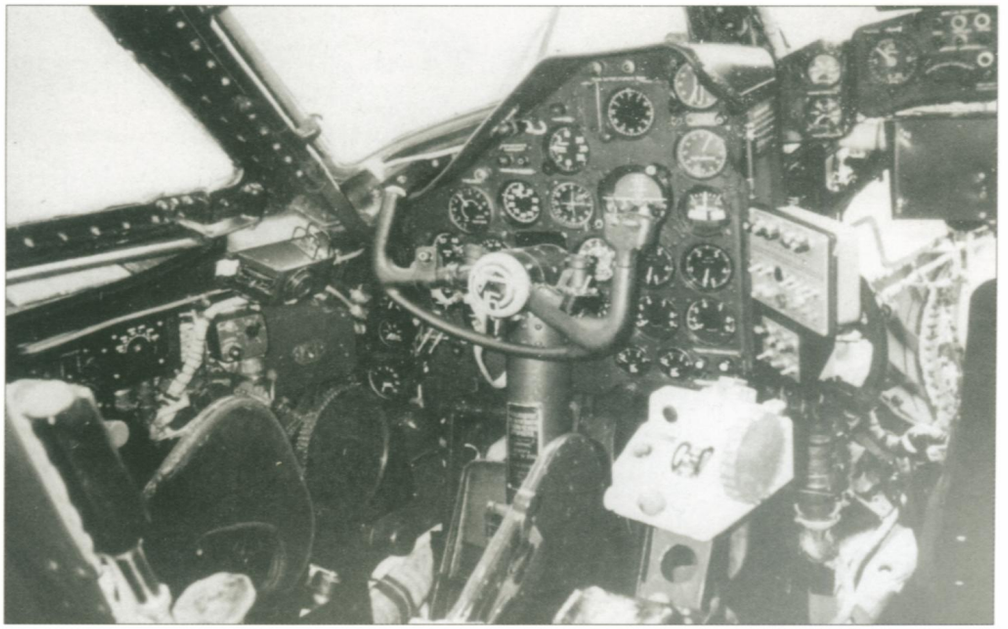
De-icing System

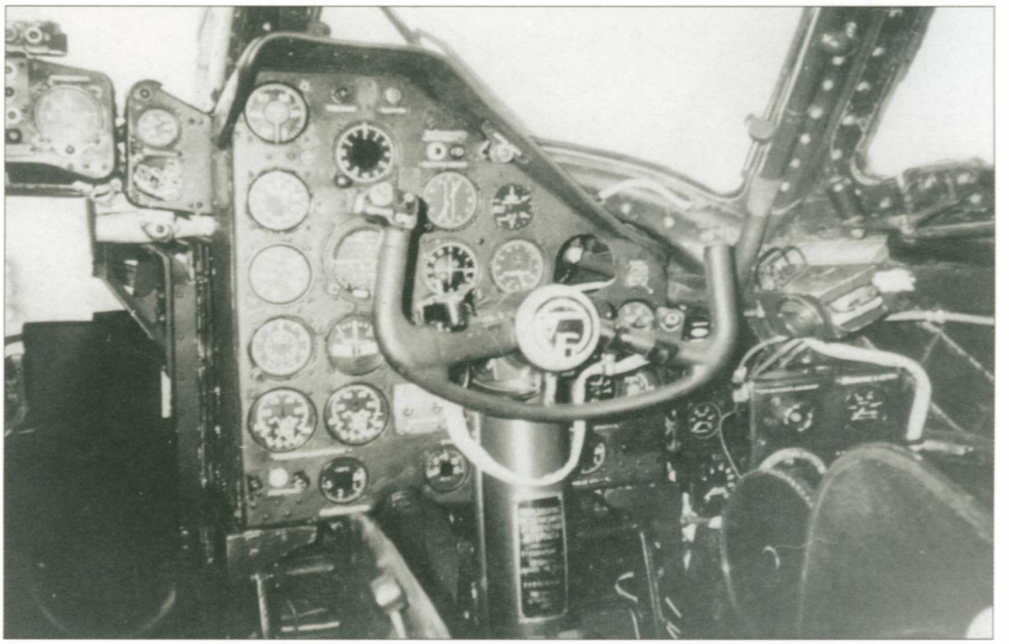
The hot air de-icing system comprised two separate subsystems: one for de-icing the leading edges of the wings and one for de-icing elements of the engine housings. The wing leading edge de-icing system was fed by two branch pipes which distributed air bled from the eighth compressor stage, the port wing being supplied from the port engine and the starboard wing from the starboard engine. Both main supply pipes were connected so that if one engine failed the system could still be supplied by the other engine. The de-icing system for elements of the engine housings heated the air intake leading edges, the

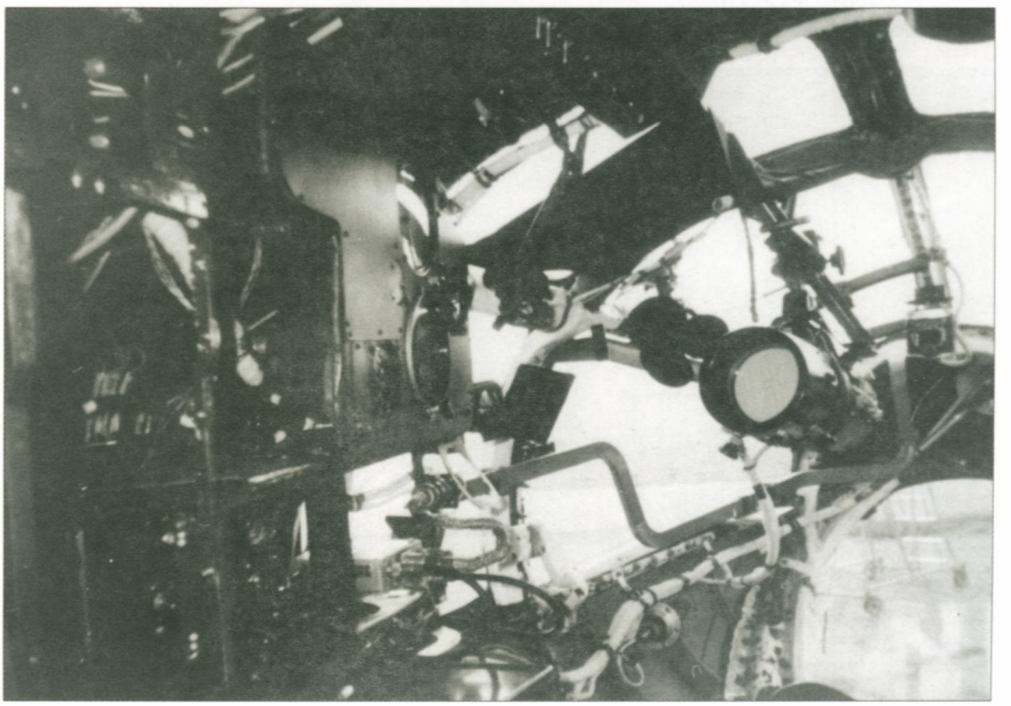
The captain's ejection seat, control column and instrument panel. The large handwheel on the left operates the elevator trim tabs.

The co-pilot's control column and instrument panel. The aircraft type is marked on the control wheel hubs. The passage on the left leads to the navigator's station.

The navigator's station commanded an excellent view. The navigator sat sideways, with the principal navigation instruments on the left wall; note the radar display and the rubber-bladed cooling fan typical of Soviet aircraft.
All Yuriy Kabernik archive







dividers in the engines' inlet ducts and the turbostarter exhaust pipes. Air for this system was bled from the seventh compressor stages.

The pilots' windscreens and the forward sighting window of the navigator's station had integrated electrical heating. Additionally, all other glazing in the navigator's station and flightdeck, as well as the blisters for the optical sighting stations, were heated with hot air. The electric de-icing system featured an AOS-81M automatic regulator to prevent the glass from overheating and cracking.

Fire Extinguishing System

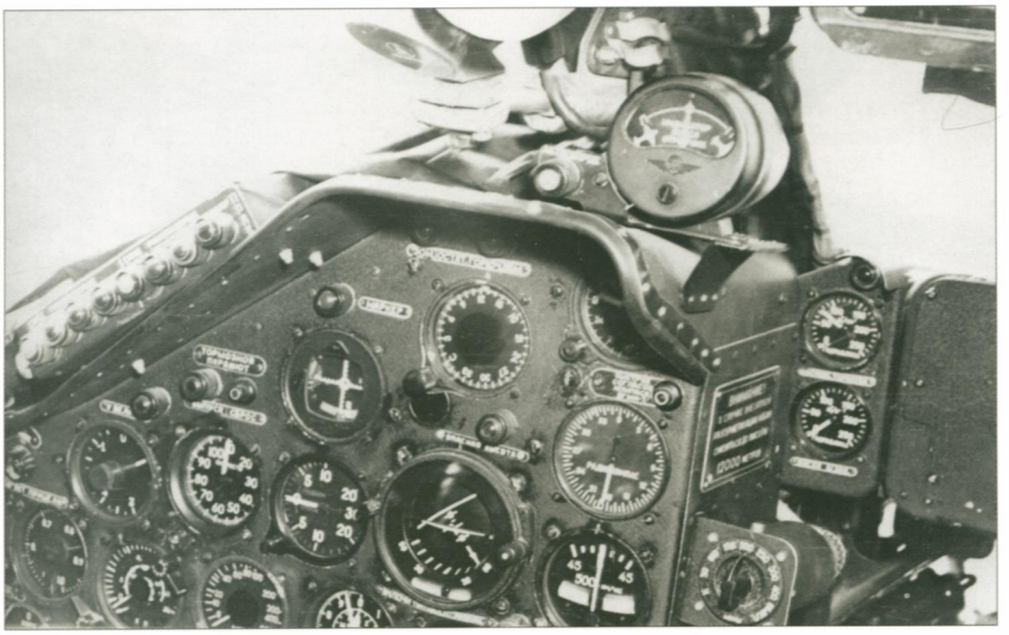
Stationary fire extinguisher bottles charged with carbon dioxide (later with grade '3.5' or 11V2 chlorofluorocarbon extinguishing agent) for fighting fires in the engine bays and fuel tank containers; several portable fire extinguishers in the crew cabins. An SSP-2A fire warning system and new OS-8M stationary fire extinguisher bottles were retrofitted as part of a mid-life update.

Avionics and Equipment

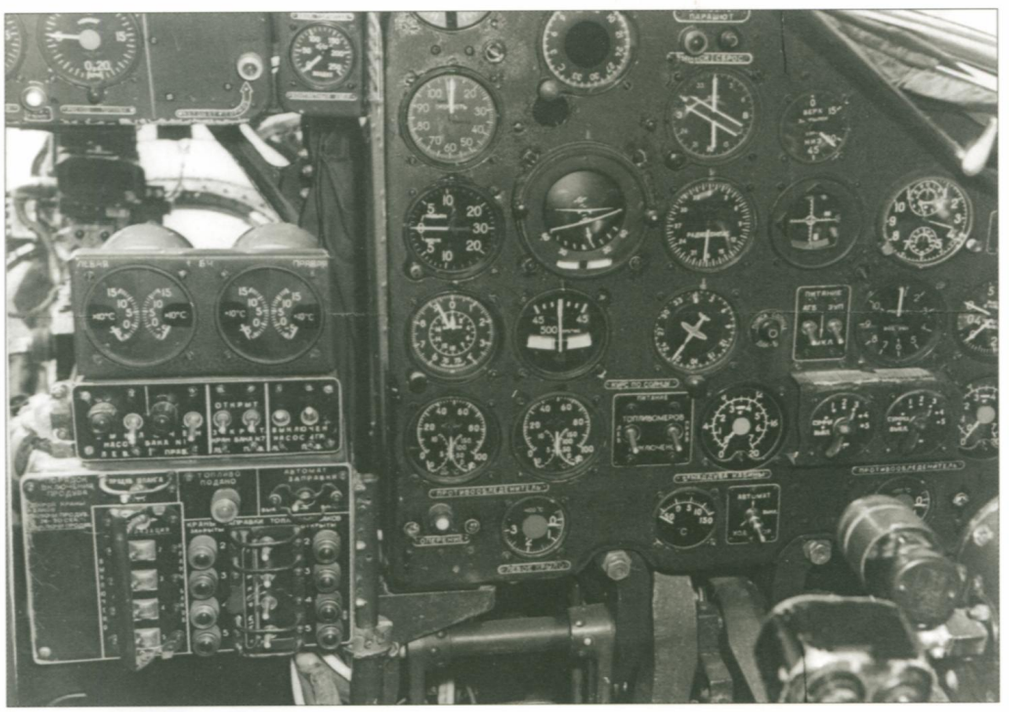
The Tu-16 was fully equipped for poor-weather day/night operation, including automatic flight assisted by an autopilot.

Navigation and piloting equipment: The Tu-16's navigation and piloting suite included:

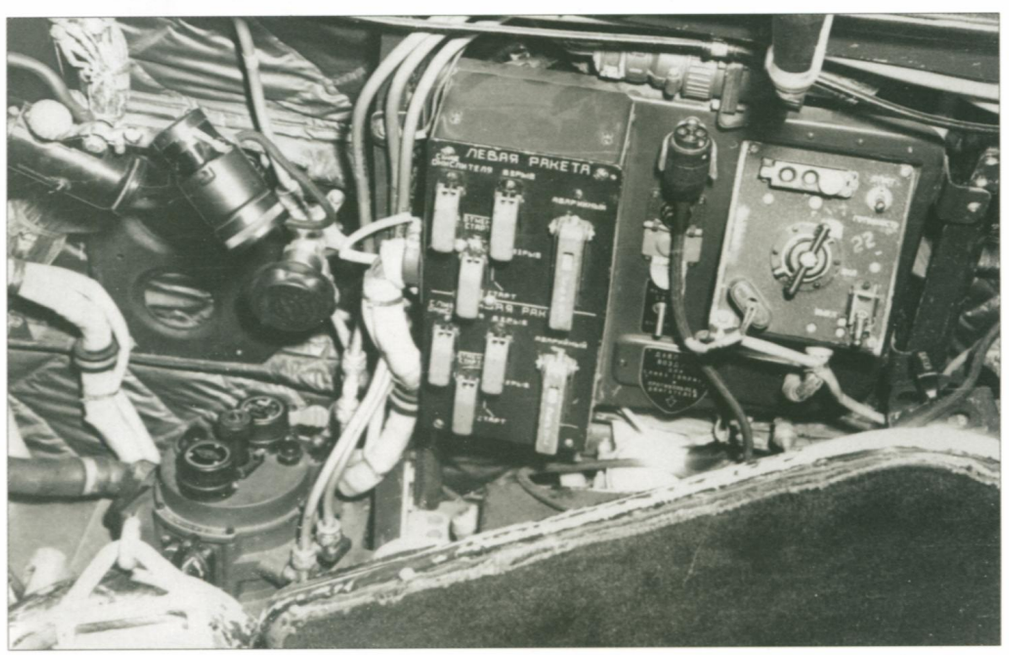
- an AK-53P celestial compass
- a DAK-2 remote celestial compass, replaced later by a DAK-DB (DAK-DB-5). Early production aircraft had the DAK-50M
- an NI-50B navigation display
- a DIK-46M remote flux-gate compass, replaced by a DGMK-7 which featured a VK-53RB correction switch
- a KI-12 (later a KI-13) magnetic compass
- a GPK-48 (later a GPK-52) directional gyro
- an SPI-1 (SPI-3M) aircraft receiver-indicator device as part of the RSDN-1 Meridian long-range radio-navigation (LORAN) system
- main and back-up ARK-5 auto direction finders
- an RV-17M high-altitude radio altimeter
- an RV-2 low-altitude radio altimeter
- an SP-50 *Materik* (Continent) short-range navigation/blind landing system comprising a KRP-F localiser receiver, a GRP-2 glideslope receiver, an SD-1 or SD-1M distance measuring equipment kit and an MRP-48P marker beacon receiver.



The Tu-16 had conventional electromechanical instruments throughout. Each of the pilots could deploy and jettison the brake parachute by pushing buttons on the instrument panel (here, they are immediately to the right of the bank of caution/warning lights). Yuriy Kabernik archive



The starboard instrument panel of a Tu-16(Z) tanker. The fuel transfer control panel is located to the left of the main panel. Yuriy Kabernik archive



The missile launch panel control of a Tu-16KSR-2-5 located on the port side console; the upper half is for the port wing station and the lower half for the starboard station. It features guarded switches for (left to right) oxidiser dumping, launch abort, warhead arming/disarming and emergency jettison of the missile. Yuriy Kabernik archive

Subsequently in the course of series production, updates, modification and service experience, the radio navigation equipment was renewed on more than one occasion and by the end of its operational life it differed slightly on different variants. On some aircraft the ARK-5 ADF was replaced by the ARK-11; others had the RV-2 altimeter replaced by the RV-UM. A DISS-1 ***Vet**er*-2 (Wind-2) Doppler speed and drift angle sensor system was fitted; the MRP-56P marker beacon receiver was replaced by the MRP-56P; an A-711 LORAN system was fitted together with the A-713M receiver; an ARK-U2 direction finder was fitted. Some Tu-16s had the RSBN-2S Svod short-range radio navigation (SHORAN) system; finally, an A-326 formation flight system was fitted.

To facilitate piloting and to ease the workload on the pilots and navigator during long flights and while bombing, an AP-5-2M autopilot was installed. This performed the following functions:

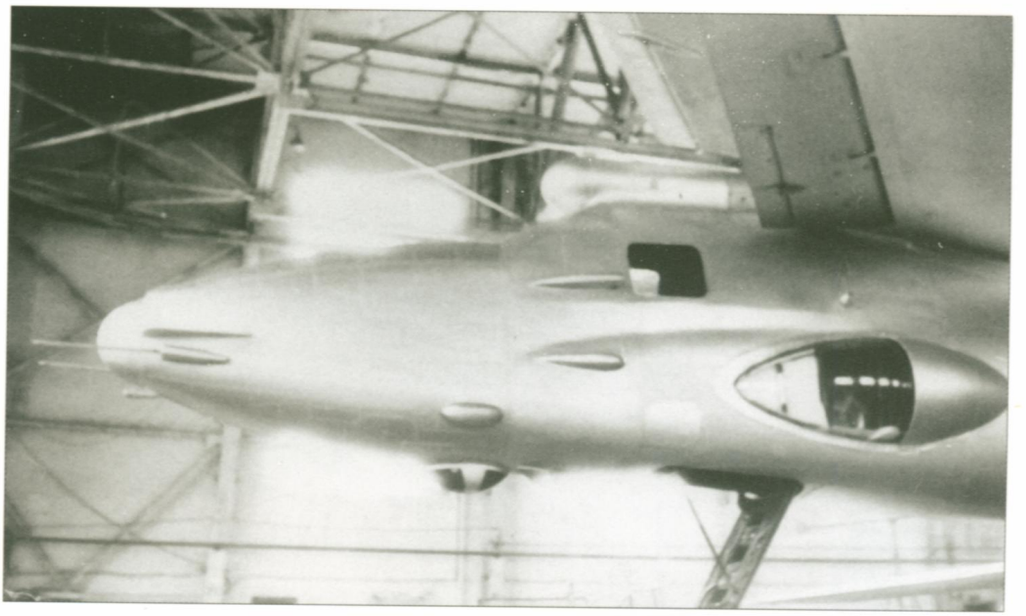
- automatically maintaining straight and level flight
- controlling the aircraft by means of the autopilot servos, using the remote control handles
- heading selection during target course settings with the aid of the optical bomb sight
- stabilisation of the optical bomb sight in the azimuth plane

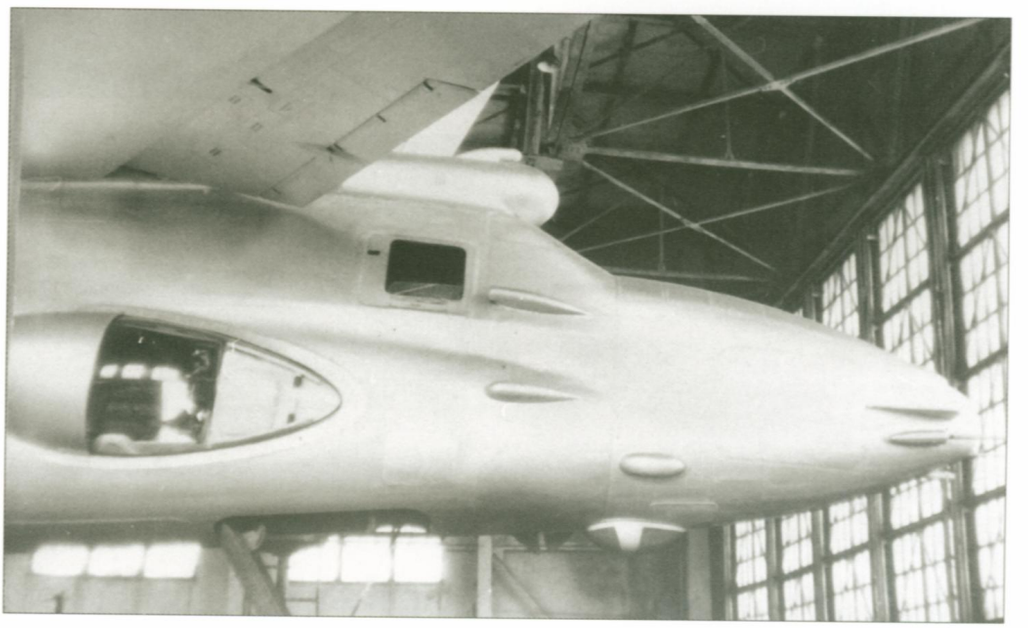
The AP-5-2M autopilot incorporated a longitudinal and lateral stabiliser, a course stabiliser, a course indicator, servos, an amplifier, a unit of precision gyroscopes, and PAG-1F and PO-45 AC converters providing electric power. From 1959 onwards AP-6E autopilots were fitted to the Tu-16; subsequently all examples produced before that date were refitted with the new AP-6E autopilot.

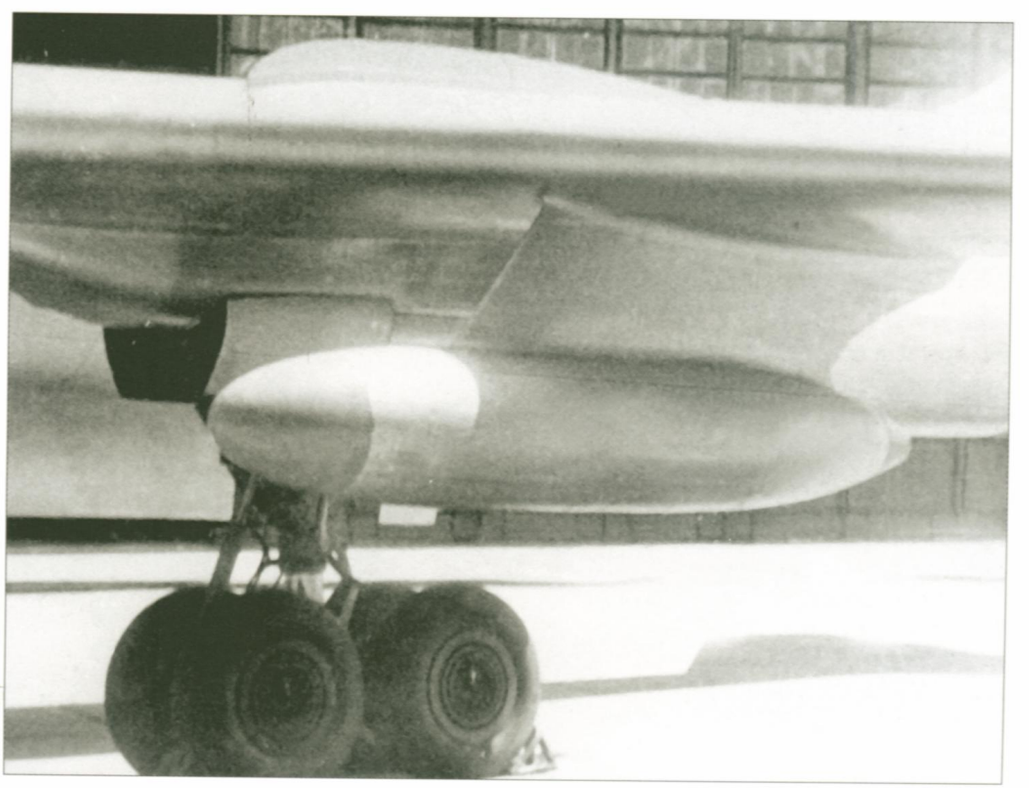
Communications equipment: The Tu-16 had the following radio equipment: a 1-RSB-70M (R-807) high-frequency (HF) communications radio with a US-9 receiver, a 1-RSB-70M (R-808) HF command radio with a US-9DM receiver, and an RSIU-3M VHF command radio with two receivers (later the RSIU-5V and R-832M *Evka**lipt*** (Eucalyptus) VHF radios were

Two views of the UKhO tail fairing of a Tu-16E Azaliya undergoing conversion to an M-16-2 target drone at ARZ No 12 in Khabarovsk. Yuriy Kabernik archive

The port underwing pod housing an SRS-3 ELINT system on a Tu-16R. Yuriy Kabernik archive







installed). An SPU-10 intercom provided crew communication.

In the course of operation an R-851 emergency SOS transmitter was fitted; there was also an AVRA-45 emergency radio, later replaced by the R-861.

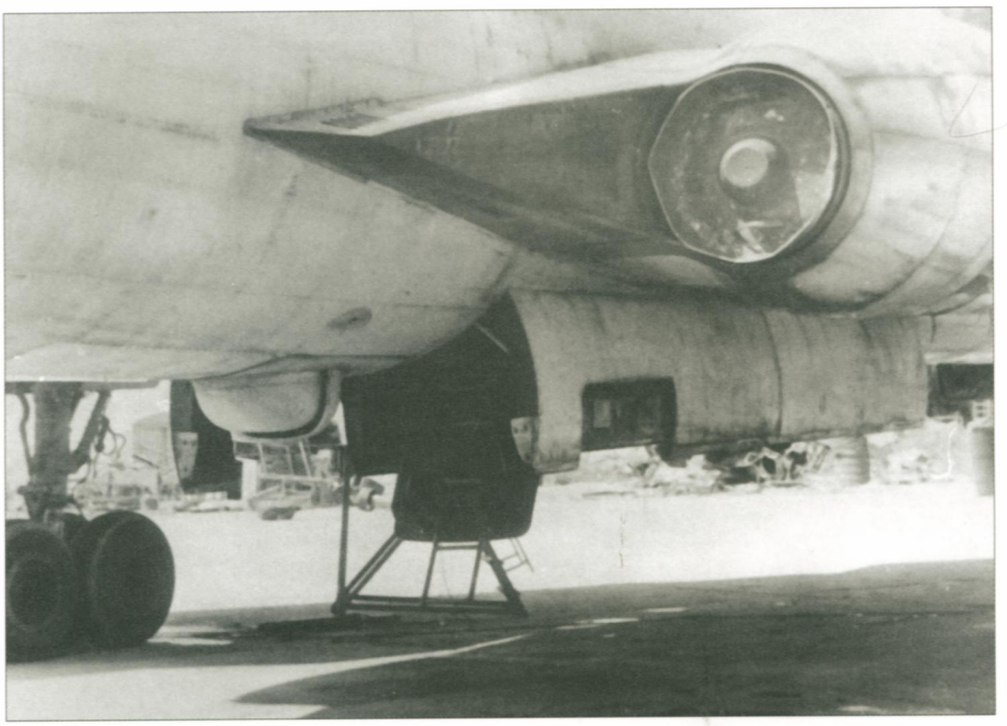
Radar and IFF equipment: The basic Tu-16 bomber featured an RBP-4 Rubidiy-MM-2 bomb-aiming radar capable of detecting large ground targets at no less than 140km range, which worked in conjunction with the OPB-11R optical bombsight. A PRS-1 Argon gun ranging radar was installed above the tail gunner's station on most versions.

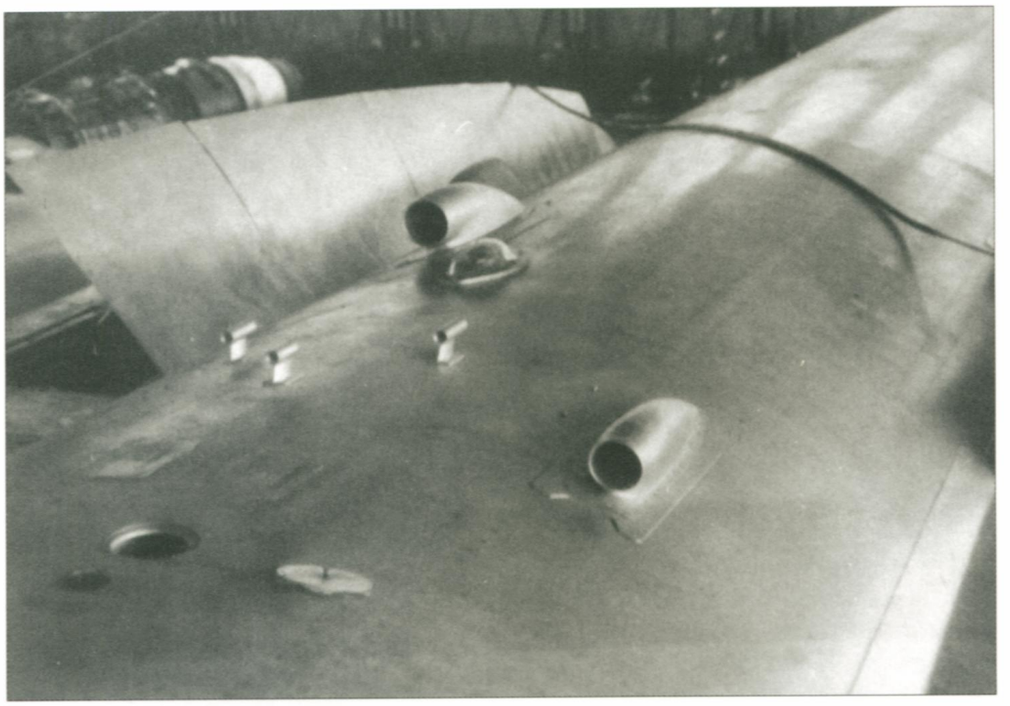
In the late 1950s a small number of Tu-16s were built with the RBP-6 Lyustra bomb-aiming radar which had improved performance and worked with the OPB-112 optical sight. Some Tu-16s were produced and modified with the R-1 bombing system (the Rubin radar plus OPB-112 optical sight).

An SRZ IFF radar interrogator (*samo**lyot**nyy **rah**diolokatsi**on**nyy za**pros**chik*) was fitted as part of an autonomous identification system (for the recognition of 'friendly' aircraft or vessels fitted with SRO or Fakel-MO transponders and for short-range radio navigation) with an operational range of 30-40km. An SRO IFF radar transponder (*samo**lyot**nyy **rah**diolokatsi**on**nyy ot**vet**chik*) with an operating range of 35km was also fitted.

ECM and ESM equipment: In the course of several refits and upgrades while in service, the Tu-16 had various types of active ECM equipment, ELINT equipment and radar warning receivers fitted which differed on various versions of the aircraft and was constantly updated. Towards the end of their service lives, the bomber versions (Tu-16 and Tu-16A) had the SPS-5 (SPS-5M) active jammer and the Sirena-2 RWR fitted.

Flight Instrumentation: The pilots' and navigator's instrument panels featured an AGB-1 artificial horizon (replaced later by the AGB-2, and then by the AGB-3 and AGD-1); a KUS-1200 airspeed indicator; a VD-17 altimeter (later VD-20); a VAR-30-3 vertical speed indicator; an SSN-3 dynamic pressure indicator; a BSPK-1 unit for (comparison?) and banking limits, installed during squadron service; an EUP-46 turn angle indicator (later EUP-53); an MS-1 Mach meter; a AM-10 accelerometer; an IAS-51 aircraft sextant; AChKhO and AVR-M clocks (later the AChS-1); a UVPD-15 altitude and falling pressure indicator; a VS-46 high-altitude pressure warning indicator and a TUE thermometer.





The following engine instruments were installed: TE5-2 electrical remote-controlled tachometers for the engines and TE-45 tachometers for the turbostarters; TVG-11 and TVG-29 exhaust gas thermometers; a TTsT-13 thermometer; an EMI-3R three-needle electric indicator showing fuel pressure, oil pressure and oil temperature; an EDMU-3 electric remote-controlled standardised manometer; RTS-16 (later RTS-16A) fuel consumption gauges, and fuel gauges making up part of the SETS-60D fuel metering kit.

The basic flight/navigation and engine instruments were located on the instrument panels in the crew cabins and only a few were positioned elsewhere.

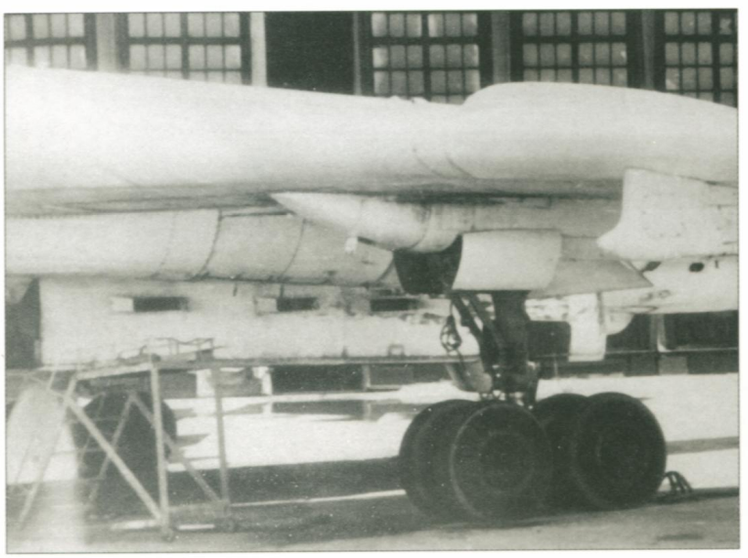
The antenna location on the Tu-16s built in the 1950s were as follows. The 1-RSB-70M radios and ARK-5 ADF used 'towel rail' or strake aerials on the fuselage; the aerial of the RSIU-3M radio and the KRP-F localiser antenna were located at the top of the fin. A whip antenna for the SPI-1 receiver-indicator and another aerial for the ARK-5 were located aft of the flightdeck (the ARK-5 antenna was glued to the dorsal observation blister). The GRP-48 glideslope receiver antenna was mounted on

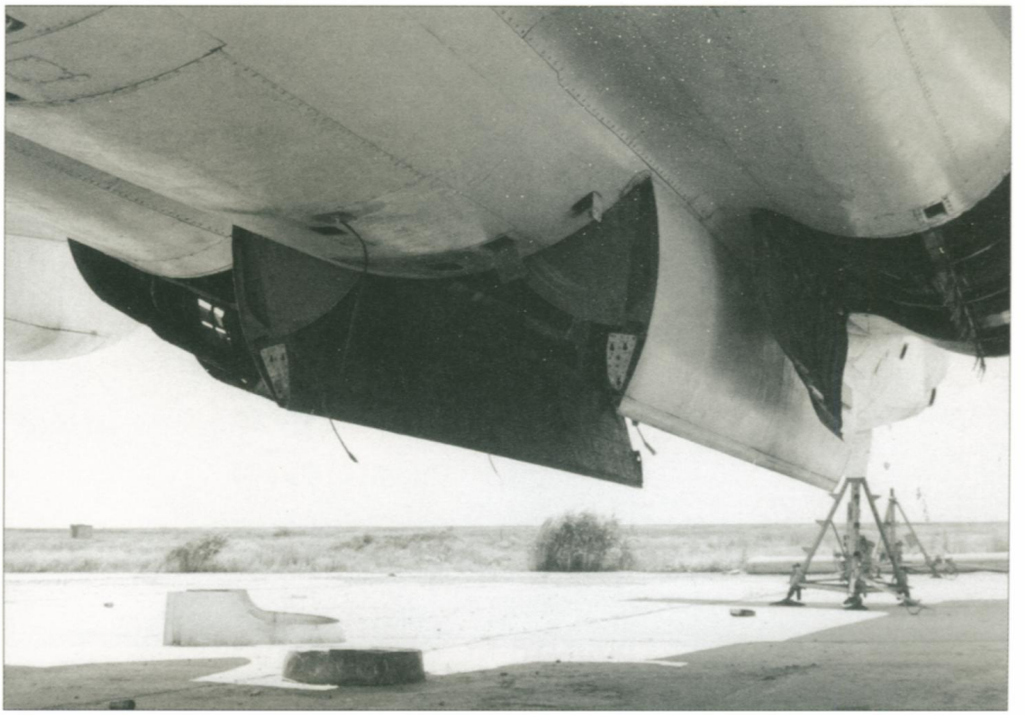
Top left: **This view shows the open bomb bay doors and the access hatch to the drone launch operator's station on Tu-16KRME '08' (c/n 1883704).** Yuriy Kabernik archive

Left: **The dorsal intakes and outlets of the Azaliya jammer's heat exchangers on Tu-16E Azaliya '61 Red' (c/n 8204203) at ARZ No 12. Note the open engine cowling and the faired dorsal anti-collision light between the air intakes, with three pitot heads further forward.** Yuriy Kabernik archive

Bottom left: **The starboard bomb bay door of Tu-16KRME '08' (c/n 1883704) features three outlets of the ASO-16 chaff dispenser.** Yuriy Kabernik archive

Bottom right: **The faired starboard antenna of the Siren' jammer on M-16-3 '61 Red' (c/n 1882216).** Yuriy Kabernik archive





Another view illustrating the Tu-16's bomb bay door design. Yefim Gordon

the navigator's station glazing; the dipole aerials of the RV-17 and RV-2 altimeters, as well as the aerials for the SD-1 DME and the SRO IFF were under the fuselage. The SRZ IFF interrogator aerials were mounted under the wings and ahead of the flightdeck windscreen. Beneath the flightdeck was a radome housing the RBP-4 radar antenna. Subsequently the types of aerials and their positioning changed in the course of the numerous upgrades of radio communications and radar equipment as well as with the appearance of new versions of the aircraft.

Photographic equipment: To carry out the limited range of reconnaissance duties, including photographing targets of opportunity, as well as post-attack reconnaissance, the following photographic equipment was carried:

- a set of AFA-33/50M (low-altitude), AFA-33/75M and AFA-33/100M cameras for daylight photography
- a set of NAFA-3S/50 or NAFA-6/50 cameras for night photography
- a FARL-1 camera for photographing the screen of the RBP-4 radar
- an AKAFU-156N automatic swivelling camera mount (for all types of daylight cameras listed above) which enabled two-strip vertical and oblique photography; a mount for night cameras; a camera hatch and a control panel for the hatch and the AKAFU camera mount

Only one camera could be installed on the Tu-16 at any one time (excluding the FARL-1 which was always fitted) and only one camera mount. The photographic equipment was housed in the fuselage (section F-3) aft of the nosewheel well.

The bomb bay could house 24 FOTAB flare bombs for recce missions flown by night.

Starting with c/n 6203401, the Tu-16 was fitted with a swivelling mount for the AFA-34-OK and AFA-42/75 cameras and the AFA-BAF-40R training camera. Aircraft from c/n 7203509 onwards were fitted with an NAFA-MK/75 camera for night photography.

Until 1957 the set of cameras fitted was decided in squadron service, depending on the needs of the particular unit. However, that year the following photographic equipment became standard for the Tu-16. One aircraft in every three was fitted with the AFA-34-OK, AFA-BAF-40R and NAFA-6/50 cameras. From July 1957 onwards each Tu-16 had an AFA-34-OK and an AFA-42/75 camera, and one aircraft in every three had an AFA-BAF-40R and an NAFA-MK/75. At the end of the 1950s the FARL-1 was replaced by the FARM-2 camera, and the PAU-457-4 gun camera was fitted to record the screen of the PRS-1.

Data recording equipment: In squadron service the Tu-16 was retrofitted with the MSRP-12 flight data recorder (FDR). Some examples had the KZ-63 backup FDR fitted. The primary FDR captures 12 parameters, including barometric altitude, indicated airspeed, roll rates, vertical and lateral G forces, control surface deflection and throttle settings, as well as gear/flap transition and the like. The backup FDR records only altitude, IAS and vertical G forces.

An MS-61 cockpit voice recorder was retrofitted in service. Some machines had an MIZ-9 CVR.

Crew Escape System

In the event of an emergency in flight, all crewmembers were provided with ejection seats. These were devised in OKB-156 and this particular model was only used on the Tu-16. The pilots ejected upwards. Before ejection their seats were forcibly slid into the extreme aft position, after which the flightdeck roof hatches were jettisoned and the control columns folded away to prevent injury. The remaining crewmembers (navigator, WSO, gunner/radio-operator and tail gunner) ejected downwards after the hatch covers below the seats had been jettisoned. The G force on ejecting upwards was 15-18 Gs, lasting 0.2 to 0.3 seconds; the initial ejection speed was 20-22m/sec to ensure that the pilots' seats cleared the vertical tail. The G force for those ejecting downwards was 3-5 Gs.

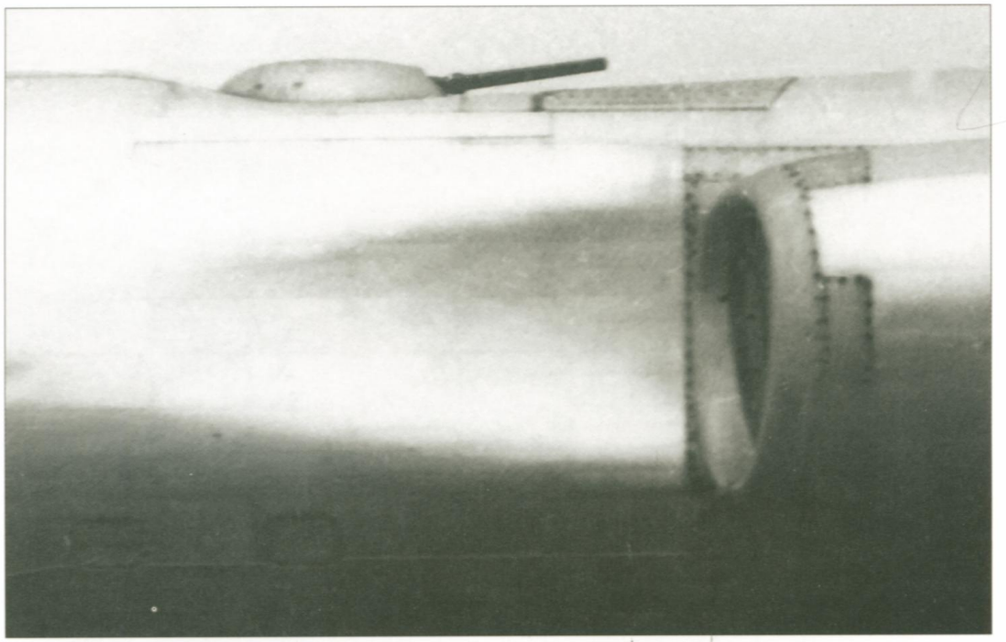
Each seat had a pan attached to a movable frame on which it could move along guide rails firmly secured to the fuselage. Each seat had a base, a back, a headrest and grab handles. The piston of the ejection gun was rigidly attached to the seat frame, and its cylinder to the fuselage structure. The head of the piston was packed with a cartridge which exploded when the firing pin was pulled by means of a handle, creating high pressure which forced the piston out, carrying the seat with it.

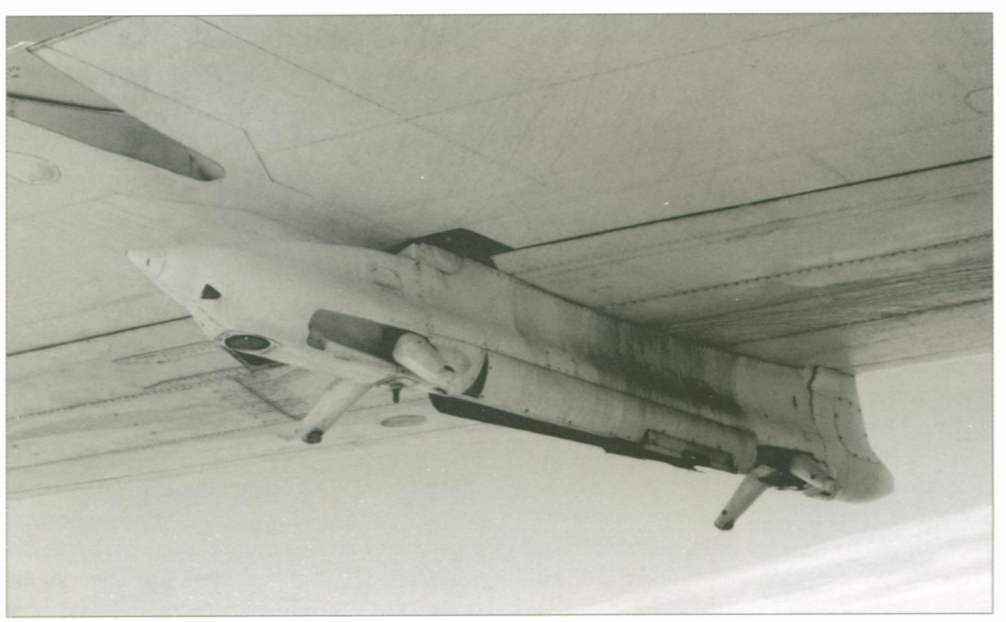
In the event of a ditching or a belly landing the crew in the forward cabin could escape through a hatchway in the cabin roof, while the crew in the rear cabin could escape through an emergency window in the rear glazing. The aircraft was able to remain afloat long enough for the crew to use the life rafts, and its ability in this respect was significantly improved if the fuel had been dumped before the aircraft ditched.

Two LAS-5M five-man inflatable life rafts were carried. These were stored in special boxes in the upper part of the fuselage on the port side between frames 12-15 (for crew members in the forward cabin) and between frames 62-63 (for those in the aft cabin). On release, the dinghies were inflated by carbon dioxide from the two bottles attached to them. Each crew member had his own first-aid kit, thermos flask and emergency rations. When the crew abandoned the aircraft they took with them the emergency and emergency SOS radios. In the 1980s the Soviet Air Force and Soviet Navy started providing the Tu-16s with radio beacons working with the KOSPAS search and rescue satellite system (*kos**mich**eskaya sis**tem**a **po**iska ava**reey**nykh soo**dov***).

Armament

The Tu-16 had typical bomber armament. The bomb racks, bomb hoists and the release and locking mechanisms for the bomb load were housed in the bomb bay between fuselage frames Nos 33 and 49. The bomb bay was 6.702m long. The sights, release mechanisms and bomb bay door control panels were located in the forward pressurised cabin. In addition to the main bomb bay, there was a compartment housing two DYa-SS box-type racks for TsOSAB coloured marker/signal flare bombs or SMAB maritime marker bombs. Depending on the composition of the bomb load, the following racks were fitted in the bomb bay:





- six KD3-488 cassette-type four-shackle racks with Der3-48 shackles
- four KD4-388 two-shackle racks with Der4-49 shackles
- an MBD6-16 beam-type rack with Der6-5 shackles

The bomb release control system was electrically operated and divided into normal bombing and emergency controls, each of which had its own independent electrical wiring to the release mechanism. The basic control was the normal bombing control which functioned in conjunction with the sight, electric releases, and the bomb release mode relay used for selecting the sequence and intervals in which the bombs were dropped. The lifting and lowering of bombs was carried out using BL-47EM electromechanical hoists with the aid of cables, belts, pulleys and crosspieces. Control of the electrical winches was effected using a special mobile control panel which was part of the ground equipment.

The normal bomb load was 3,000kg and the maximum bomb load 9,000kg. Bombs of 5,000-kg, 6,000-kg and 9,000kg calibre were suspended on the MBD-16 beam-type rack; smaller bombs were carried on KD3-88 and KD4-288 cassette-type racks attached to the bomb bay walls. When the Tu-16T torpedo-bomber was used on naval theatres of operations, carrying mines and torpedoes, the latter were suspended from the KD3 and KD4 racks. The maximum load of mines and torpedoes was 8,700kg. The aircraft was fitted with an ESBR-49A electric release mechanism enabling single weapons or 'sticks' of bombs, mines or torpedoes to be dropped throughout the Tu-16's altitude and speed envelope. The bombing system drew its electrical power from the two-circuit electrical wiring system.

Bomb-aiming was done by means of an OPB-11R vector-synchronised optical sight with automatic drift correction linked to the AP-5-2M autopilot, thanks to which the aircraft could be automatically held on course by the navigator during bomb-aiming. Some Tu-16s had an OPB-112 sight which operated in conjunction with the RPB-6 Lyustra or R-1 Rubin-1 radars. The optical sight was located in the navigator's station in the extreme nose.

The DT-7V twin-cannon powered dorsal turret is located directly ahead of the engine air intakes. Note the steel gun blast plates riveted to the upper fuselage skin. Yefim Gordon archive

Like the dorsal turret, the DT-7N powered ventral turret is recessed as much as possible to cut drag and provided with gun blast plates protecting the fuselage skin. Yefim Gordon

The port BD-352 missile pylon of a Tu-16KSR-2-5; the retaining arms are deployed and the maintenance cover in the middle is open. Note the cutout in the wing flap accommodating the pylon's rear end at maximum deflection. Yefim Gordon

If the target was not visible, bomb-aiming could be carried out using the RBP-4 Rubidiy-MM-2 (or RBP-6, or R-1) radar. In these instances bombing accuracy was increased since the OPB-11R (or OPB-112) was linked to the radar sight and computed the necessary parameters for it: the slant range, the lateral stabilisation angle and the azimuth stabilisation angle.

The dropping of bombs, mines and torpedoes was carried out by the navigator, but could also be done by the WSO (radar operator) with the aid of a release switch. In this instance, all parameters for the drop had to be drawn up by the navigator. The bomb bay doors opened and closed hydraulically; if the hydraulic system failed they could be opened by a spring-loaded mechanism. The opening and closing of the bomb bay doors was electrically controlled by the navigator.

When the bombs were released using the OPB sight, the bomb bay doors were opened immediately before release. The emergency opening of the bomb bay doors, as part of the emergency jettisoning of the bomb load, was carried out by the navigator and the co-pilot. The pilots operated the secondary bomb bay door closing system. Kazan'-built Tu-16s up to and including c/n 5201801 had lights in the main gear fairings which the lead aircraft used to indicate the start of bomb dropping to the wingmen.

During night operations 12 TsOSAB-10 or SMAB signal/marker bombs could be carried on DYa-SS racks. These were released by the navigator.

The Tu-16 could carry the following types of ordnance:

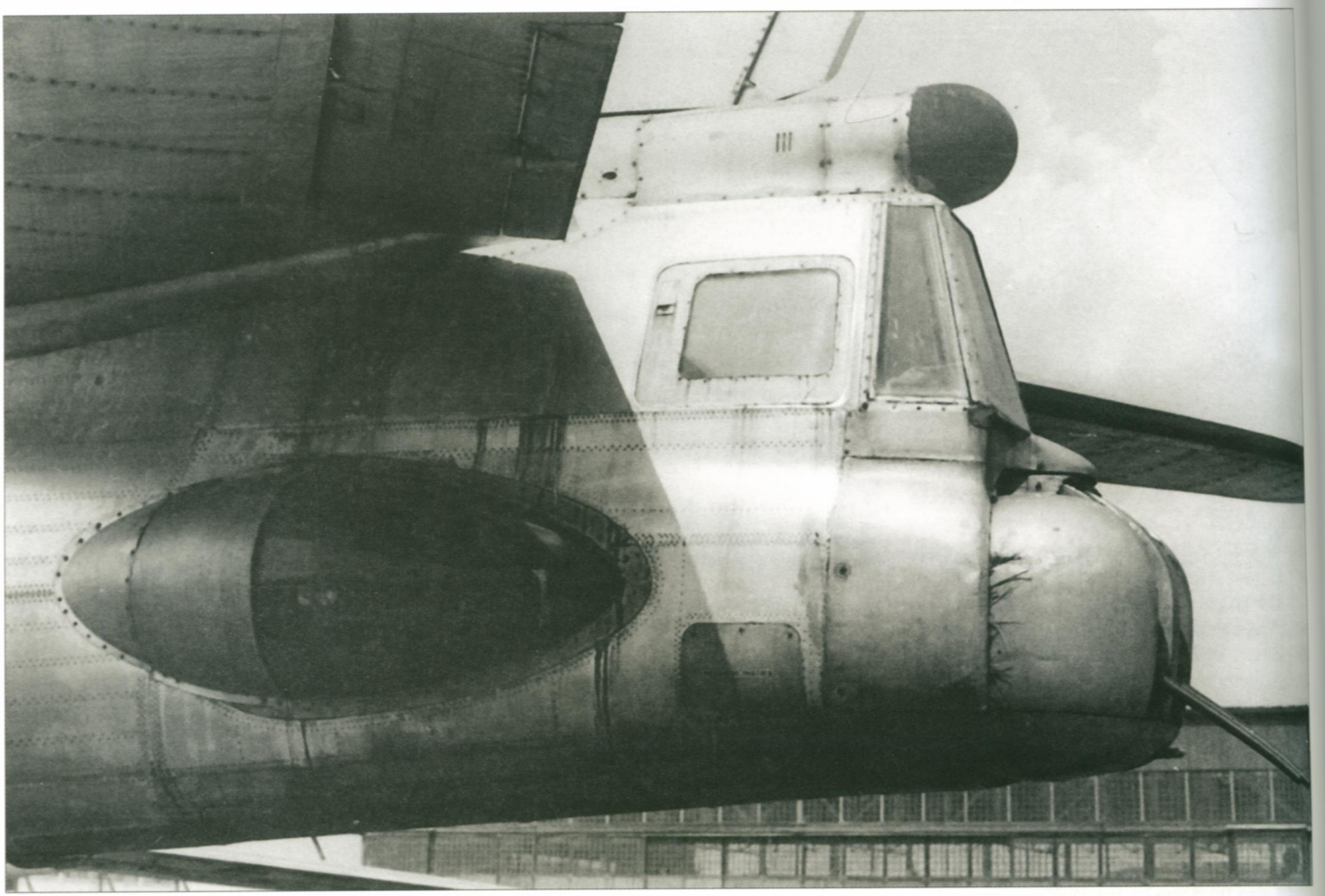
Type	Number	Total weight
Bombs		
SAB-100-75 flare	16	1,152kg
FotAB-100-80 flare	24	1,920kg
FAB-250M46 high-explosive	24	5,253kg
FAB-250M54	24	5,660kg
FAB-500M46	18	7,686kg
FAB-500M54	18	8,386kg
FAB-1500M46	6	8,871kg
FAB-1500M54	6	9,324kg
FAB-3000M46	2	5,963kg
FAB-3000M54	2	6,116kg
FAB-5000M54	1	5,220kg
FAB-9000M54	1	9,290kg
FAB-250M43	16	4,000kg
FAB-500M43	12	5,706kg
FAB-1000M43	4	4,380kg
FAB-2000N43	4	8,260kg
BrAB-6000 armour-piercing	1	
Mines		
AMD-500	4 and 12	
AMD-1000	4	
AMD-2M	6 and 8	
IGD-M	8	
Serpei	6	
Desna	8	
Lira	8	
Torpedoes		
RAT-52	4	
45-36-MAV	6	

The Tu-16 was equipped with an EKSP-39 electric flare launcher (*elek**trich**eskaya kas**set**a sig**nahl'**nykh pat**ron**ov*) firing four 39-mm signal flares (red, green, yellow and white).

A passive ECM system could be carried in the bomb bay, with an attendant reduction in the bomb load. Some production Tu-16s had ASO-16 Avtomat-1 chaff dispensers; earlier production examples were modified to incorporate the ASO-16 system. In the 1970s the ASO-2B Avtomat-2 chaff dispenser was installed on the Tu-16. Bomber versions (the Tu-16, Tu-16A and Tu-16ZA) had three ASO-16 or ASO-2B units in the bomb bay between frames Nos 46 and 48. The bomb load could be reduced if necessary.

A close-up of the DT-7N ventral turret. Yefim Gordon

This view of a retired Tu-16 reveals the internal structure of the DK-7 tail turret and the ammunition feed sleeves. Note the partially open port side escape hatch and the ventral access/ejection hatch. Yefim Gordon



The tail gunner's station, the DK-7 tail turret and the associated PRS-1 Argon-1 gun-laying radar. The AM-23 cannon are at maximum depression on this preserved aircraft. Note the port side escape hatch of the tail gunner's station. Only the rear halves of the lateral sighting blisters are transparencies, the forward halves being made of metal. Yefim Gordon

Also in the 1970s some Tu-16s were retrofitted with ASO-2I flare dispensers for releasing infrared countermeasures flares. Three sets (six 32-round units) were fitted in the rear fuselage and in both main gear fairings.

For defence against fighter attacks the Tu-16 featured the PV-23 cannon system which consisted of the following:

- seven remote-controlled Afanas'yev/Makarov AM-23 cannon in four positions, of which three were twin-cannon powered turrets (the DT-V7 dorsal barbette, DT-N7S ventral barbette and DK-7 tail turret) and one (the PU-88 mount) had a single fixed forward-firing cannon
- the components of the remote control system for the powered turrets synchronising cannon movement with that of the sighting position (the MA-500 converter, the KS-3 and KS-4 synchro-sensors and receivers, the SU-3R and EMU U-700 servo-amplifiers, the DV-1100A drive motors, control panels, AP-10 automatic cocking devices, round counters and S-13 gun camera for the PU-88)
- the components of the sighting computer unit which provided corrections to the lead angle (on examples up to and including c/n 4200603 the PS-48MM sighting computer unit was fitted, replaced by the PVB-53 from c/n 4200604 onwards)
- the optical sights – the pilot's PKI collimator sight for the PU-88, the PS-53-VK dorsal sighting station, the PS-53-BP starboard blister station, the PS-53-BL port blister station, the automatic devices for air gunnery (the AVS-53 automatic correction computer, the DSP-53 speed and density sensor, the VSP-53 computers for speed and density. and the ADP-53 automatic auxiliary parallax, up to and including c/n 4200603 the PS-48MM sighting stations were fitted
- the PRS-1 Argon gun ranging radar for gunnery under all conditions of visibility

The PU-88 cannon installation was intended to fire ahead in the direction of flight and its fixed cannon with 100 rounds was fitted on the starboard side of the nose. It was operated by the captain who used a PKI sight on a folding bracket.

The three powered turrets (the DT-7V, DT-N7s and DK-7) covered the rear hemisphere; additionally, the DT-7V covered the upper part of the forward hemisphere. The field of fire of the DT-7V was 360° in the horizontal plane, with 90° elevation and 3° depression. 500 rounds were provided (250 rounds per gun). The main control of the dorsal position was exercised from the WSO's dorsal sighting post. Auxiliary control could be exercised by the rear gunner from the rear sighting station.

The DT-N7S turret had a ±95° field of fire in the horizontal plane in the rear hemisphere, 2°40' elevation and 90° depression. The full ammunition supply was 350rpg. Main control was from the gunner/radio-operator's two (port and starboard) blister sighting posts. Auxiliary control could be exercised from the rear sighting post by the rear gunner.

The DK-7 had a ±70° field of fire in the horizontal plane in the rear hemisphere, an elevation of 60° and a depression of 40°. The full ammunition supply was 1,000rpg. The main control was from the rear sighting post by the rear gunner, who was in charge of all the gun positions. Auxiliary control could be exercised from the dorsal sighting post by the WSO, or from the ventral sighting post by the gunner/radio-operator. The PRS-1 radar permitted fire in the rear hemisphere within ±35° in the horizontal plane with an elevation and depression of ±35°.

Characteristics of the AM-23 Cannon

Calibre	23mm
Weight of shell	200 grams
Muzzle velocity	690m/sec
Rate of fire	1,300 rounds per minute
Weight	43kg

The Tu-16 in Service

The first production Tu-16 bombers began to enter squadron service with the Soviet Air Force (VVS – *Vo**yen**no-voz**doosh**nyye **see**ly*) in February-March 1954. During the May Day parade in Moscow that year a formation of nine Tu-16s passed over Red Square.

At the beginning of the 1950s the piston-engined Tu-4 was the backbone of the Soviet heavy bomber force (DA). The introduction of an aircraft belonging to a new generation – or, more accurately the new jet era – demanded changes in the Long-Range Aviation's order of battle, the fundamentals of its operational training, and radical improvements to its airfield network and supply system. The significant differences between the Tu-4 and Tu-16, particularly in speed, called for a modernisation of existing airfields – concrete runways had to be strengthened and extended, taxying strips and parking areas reorganised. New storage facilities were built for fuel and lubricants to cope with the large quantities of kerosene required and airbases were provided with new radio communications systems and navigation aids.

Initially heavy bombers were parked in long rows on the flightlines. The Tu-16 gained the distinction of being the DA's first type to use dispersed parking in earthen revetments (which were sometimes covered with camouflage netting) to minimise vulnerability to air raids and missile strikes. The appearance of the Tu-16 required a complete overhaul of all airfields used by the Long-Range Aviation – all were upgraded to 1st class, and often to an even higher grade, able to take practically any kind of aircraft, including the main Soviet strategic bomber, the Tu-95. Civil airfields equipped to these standards did not come into being until the end of the 1950s.

In the mid-1950s the Tu-16 was already being built in large quantities and by the end of the decade had become the DA's standard bomber type. It retained this position until the mid-1980s when it was gradually replaced by the third-generation long-range supersonic Tu-22M. This dominating position also extended to the Soviet Naval Air Arm for the same reasons. The Tu-16 remained in service until 1994. Several air regiments equipped with the Tu-16 never made the transition to the Tu-22M after the disintegration of the USSR in late 1991.

The Tu-16 was induced into squadron service rapidly, successfully and without any undue difficulties thanks to the thought which had gone into its design and the shrewd choice of stability and handling attributes under different flying conditions. At cruising speeds the gradient of stick forces was within the acceptable limits for heavy aircraft (30-100kg). At high Mach numbers they increased more steeply: at an altitude of 10,000m with a speed equivalent to Mach 0.9 and a centre of gravity at 21% MAC the stick forces reached 120-130kg and handling became more difficult. The Tu-16 was stable up to Mach 0.83, with some instability, but not causing too much trouble, appearing at speeds of Mach 0.83-0.87. At Mach 0.87 the aircraft became stable once more – in fact significantly more stable than at lower speeds.

The aircraft's highest Mach number determined by its longitudinal stability and controllability was limited to 0.9 at altitudes up to 10,000m. Higher speeds below 10,000m gave rise to an inadmissible increase in all control forces and the machine became to all intents and purposes uncontrollable. The Tu-16 could only exceed Mach 0.9 in a dive from 10,000-13,000m in order to evade SAMs.

As far as lateral stability was concerned, the aircraft behaved normally at speeds up to Mach 0.8. At higher speeds lateral stability declined sharply until, between Mach 0.87 and 0.9, it became neutral, and was then lost as speed was increased further. This induced a reverse roll reaction to rudder inputs (that is, the aircraft rolled right instead of left when left rudder was applied).

During squadron service, the following indicated airspeed limits were imposed:

- 645km/h with an all-up weight of 70 to 75.8 tonnes at altitudes up to 7,000m
- 685km/h with an all-up weight of 55 to 70 tonnes at altitudes up to 6,250m
- 700km/h with an all-up weight of 55 tonnes or less at altitudes up to 6,000m
- 420km/h at all altitudes with the undercarriage extended

The maximum permissible IAS with the flaps deployed was 400km/h with 20° flap and 340km/h with flaps set at greater angles. The maximum landing gear transition speed was set at 400km/h IAS.

In its 40 years of service the Tu-16 equipped many air regiments of the Soviet Air Force and the Soviet Navy. Most of these regiments had previously operated piston-engined aircraft, but some were newly organised as jet bomber units. In the course of the Tu-16's service career some of the units operating it were disbanded, others re-equipped with new aircraft, and there were some which, after operating more modern machines for a while, reverted once more to the Tu-16.

The Tu-16 served in roughly equal numbers with the Long-Range Aviation and the Naval Air Arm. By the early 1960s the Tu-16 completely

The personnel of a Soviet Air Force heavy bomber regiment equipped with Tu-16s lined up for an inspection. Yefim Gordon archive

replaced the Tu-4 in DA service. In AVMF regiments it replaced the Tu-14T torpedo-bomber and, to a certain extent, the IL-28T torpedo-bomber and IL-28R photo reconnaissance aircraft. The table below shows which versions of the Tu-16 saw service with the DA and the AVMF:

Version	Long-Range Aviation	Naval Air Arm
Tu-16	+	+
Tu-16A	+	+
Tu-16 (Z)	+	+
Tu-16N	+	–
Tu-16T	–	+
Tu-16S (SP)	–	+
Tu-16R	+	+
Tu-16RP	+	–
Tu-16 Yolka	+	+
Tu-16E	+	+
Tu-16SPS	+	+
Tu-16P Buket	+	–
Tu-16RR	+	–
Tu-16KS	+	+
Tu-16KSR-2	+	+
Tu-16KSR-2-11	+	+
Tu-16K-11-16	+	+
Tu-16KSR-2-5	+	+
Tu-16K-26	+	+
Tu-16K-10	–	+
Tu-16K-10-26	–	+
Tu-16RM	+	–
Tu-16RM-1 & RM-2	–	+

The Tu-16KRM drone launcher and the M-16 target drone were operated by the Long-Range Aviation, the Air Defence Force and the Naval Air Arm for air defence training.

Tu-16 regiments could be either part of a heavy bomber air division (TBAD – *tyazhe**lo**bombardi**rov**ochnaya **a**viadi**vee**ziya*, roughly equivalent to a Bomber Group (Heavy) in the US Air Force) or independent (that is, direct reporting units not forming part of an air division). The TBAD could consist of two, only very occasionally three, heavy bomber air regiments (TBAP – *tyazhe**lo**bombardi**rov**ochnyy **a**via**polk***, ≈ Bomber Wing, Heavy). Independent heavy bomber air regiments and divisions were attached to independent air corps (OTBAK – *ot**del**'nyy tyazhe**lo**bombardi**rov**ochnyy **a**via**kor**poos*), which in 1980 were grouped into the Air Armies of the Supreme Command (VA VGK – *voz**doosh**naya **ar**miya Ver**khov**novo **glav**noko**mahn**dovaniya*). The Long-Range Aviation consisted of either two or three air armies. When the DA was dissolved, its air armies came directly under Air Force (VVS) command. (In the modern Russian Air Force, the Long-Range Aviation has re-emerged as the 37th VA VGK.)

By the end of the 1950s the Long-Range Aviation's heavy bomber air regiments and independent long-Range reconnaissance air regiments (ODRAP – *ot**del**'nyy **dahl**'niy raz**ved**yvatel'nyy **a**via**polk***) were equipped with the Tu-16, Tu-16A, Tu-16SPS, Tu-16 Yolka and Tu-16R. The task of the heavy bomber air regiments was to carry out bombing raids deep into enemy territory, and to photograph the results of bombing raids and objects of opportunity en route to and from the target area. The reconnaissance regiments were to carry out visual reconnaissance and Elint missions by day or night in their support. Their ECM-equipped aircraft, the Tu-16SPS, Tu-16 Yolka and Tu-16E, were to be employed as required against strong enemy anti-aircraft defences.

During the 1960s some of the Long-Range Aviation's bomber regiments converted to ASM carrying versions of the Tu-16 for operations against surface vessels and strategic land targets in the European, Asian and Pacific theatres. The later availability of more modern versions of the Tu-16 with more sophisticated and powerful ECM (the Tu-16P Buket and the like) enabled the Long-Range Aviation to retain an effective strike presence on the most important sectors of potential theatres. The Tu-16 kept its functions in this respect virtually until the end of the 1980s.

The first DA air regiments to be equipped with the Tu-16 in early 1954 (and subsequently the Tu-16A) were the 402nd TBAP based at Balbasovo near Orsha and the 203rd TBAP at Baranovichi (both Belorussia), which comprised the 45th TBAD. Subsequently production examples entered service with the air regiment based at Engels-2 AB near Saratov, southern central Russia. Concurrently, several were supplied to the special Long-Range Aviation unit based at Bagherovo AB which was involved in the nuclear weapons development programme. Soon large numbers of Tu-16 were available for service with the DA units and then with the AVMF. Tu-16R reconnaissance aircraft began to reach the independent long-range reconnaissance air regiments and the Tu-16SPS (and later Tu-16P Buket) ECM versions were supplied to the independent ECM air regiments (OAP REP).

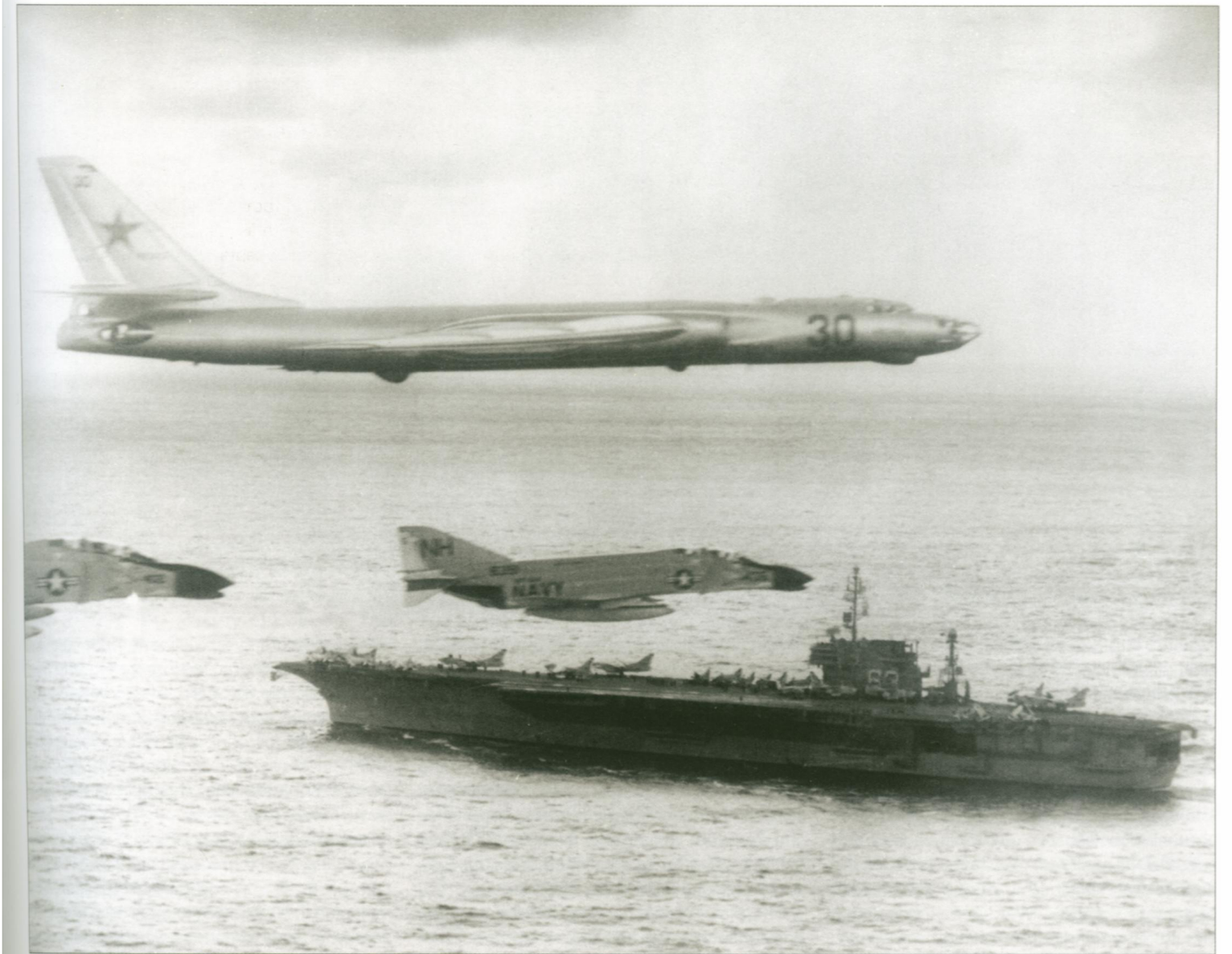
By the start of the 1960s several dozen Tu-16s in various versions were serving with the DA and the AVMF. At various times, the following Tu-16 regiments were based at the following bases:

- in the western regions of the USSR: at Tartu in Estonia (Baltic Defence District), at Sol'tsy in the Novgorod Region (Leningrad DD), Shaikovka AB near Moscow and Migalovo AB near Kalinin (both Moscow DD) [Kalinin has been renamed back to Tver']
- in the Belorussian DD: at Baranovichi, Bobruisk (two regiments), Machulishchi AB near Minsk and Zyabrovka AB near Gomel'
- in the Ukraine: at Belaya Tserkov', Nezhin, Priluki, Poltava (two regiments), Ozyornoe AB near Zhitomir, and also at Stryy AB
- in the eastern regions of the USSR: at Belaya AB in the Irkutsk Region (Transbaikalian DD, two regiments), Zavitinsk in the Amur Region, Spassk-Dal'niy and Vozdvizhensk near Ussuriysk (all Far Eastern DD).

The DA air regiments in the western defence districts formed two air armies of the Supreme

Left: **This cutaway Tu-16 airframe minus the port wing and stabiliser is used as a teaching aid at one of the Soviet Air Force's technical schools; here, an instructor in the rank of Lieutenant Colonel explains the aircraft's design details to the cadets. One of the ejection seats is displayed separately for ease of inspection. The tactical code '42' is still carried on the starboard air intake cover.** Yefim Gordon archive

Opposite page: **Escorted by two US Navy McDonnell F-4Js (and probably photographed from a third), Soviet Navy Tu-16R '30 Red' (c/n 1882309?) maintains a close interest in the aircraft carrier USS *Coral Sea* (CV 63). The Tu-16R is a Badger-E with SRS-1 and SRS-4 blister fairings but no SRS-3 underwing pods.** US Navy



Command and those in the eastern military districts one air army. After the dissolution of the USSR there was only a single such formation in western Russia.

Naval Air Arm Tu-16s were based as follows:

- with the Black Sea Fleet at Kool'bakino AB near Nikolayev, plus Novofyodorovka AB near Saki and Gvardeyskoe AB on the Crimea Peninsula (all three Red Banner Odessa DD)
- with the Baltic Fleet at Kaliningrad (Baltic DD), Ostrov AB near Pskov (Leningrad DD) and at Bykhov AB (Belarus', two regiments)
- with the North Fleet at Severomorsk-3 AB near Murmansk, Olenegorsk AB near Arkhangel'sk and at Lakhta AB in the Karelian Autonomous SSR
- with the Pacific Fleet at Knevichi AB (two regiments) and Khorol' AB in the Primor'ye Region, at Mai-Gatka AB, Mongokhta AB, Kamennyy Roochey AB near Sovetskaya Gavan' (all Khabarovsk region) and Yelizovo airport near Petropavlovsk-Kamchatskiy on the Kamchatka Peninsula
- with the Caspian Sea Flottilla – near Shevchenko [now renamed Aktau], Kazakhstan

The type also saw service with the air component of the Air Defence Force (PVO) at Priozyorsk, Kazakhstan.

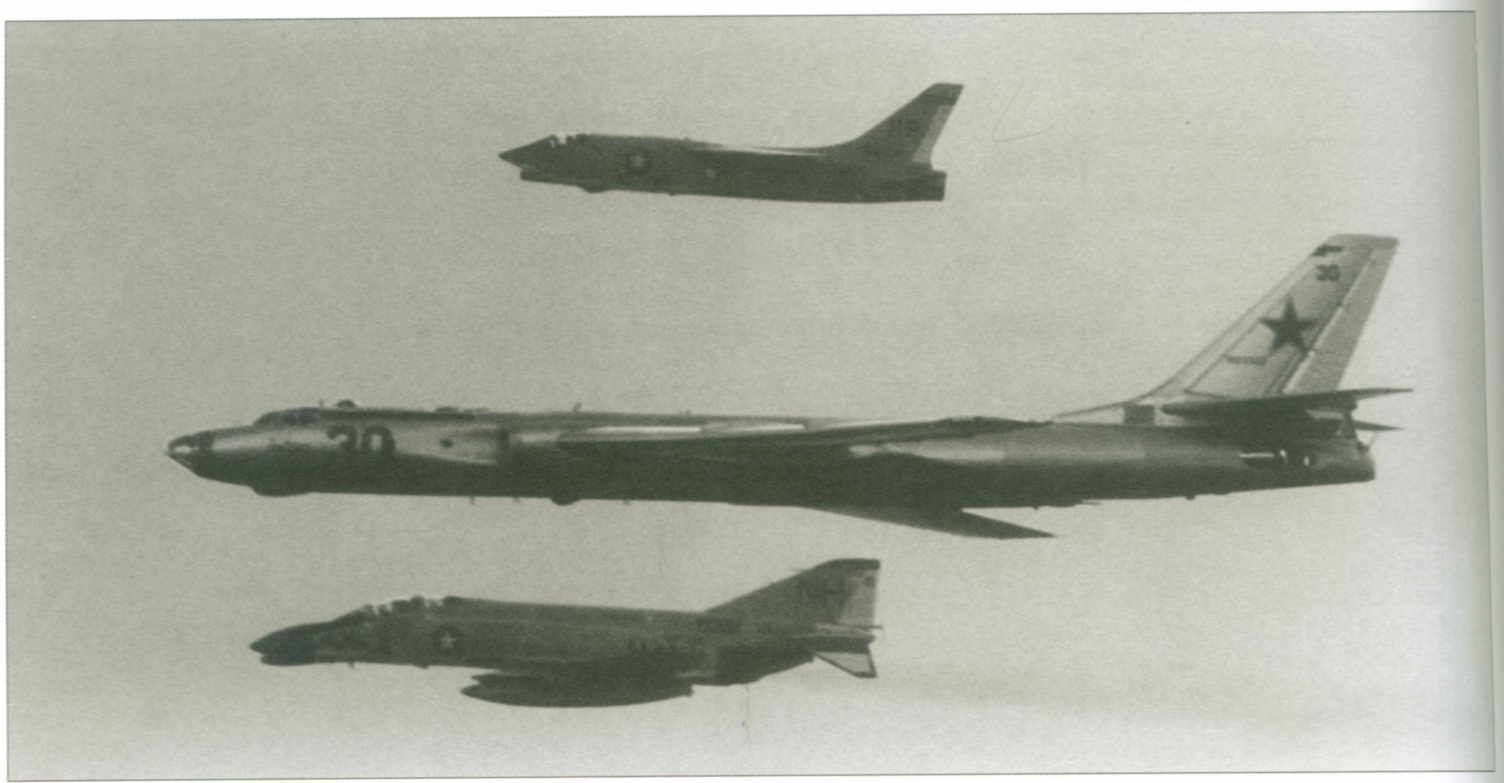
In addition to the airfields listed above, Tu-16 units were based at various times at Mozdok (Ingushetia, North Caucasian DD), Engels-2 AB, Skomorokhi AB, Oktyabr'skoe AB, and Vesyolaya AB, as well as at other locations.

The Tu-16 was also used by two of the Soviet Air Force's training establishments: the Chelyabinsk Military Navigator College (VVAUSh – ***Vys****sheye vo****yen****noye aviatsi****on****noye oo****chil****ischchche* ***shtoor****manov*), operating from Kamensk-Ural'skiy, Shadrinsk and Kustanai, and the Tambov Military Pilot College (VVAUL – ***Vys****sheye vo****yen****noye aviatsi****on****noye oo****chil****is-chche* ***lyot****chikov*). It was also used extensively by research and development establishments: by the main facility of the Soviet Air Force Research Institute (GK NII VVS) at Vladimirovka AB near Akhtubinsk, the Ministry of Aircraft Industry's Flight Research Institute (LII) and by the Tupolev Design Bureau at Zhukovskiy. After their retirement from service, Tu-16 aircraft were kept at the Soviet Air Force storage base at Chagan, Semipalatinsk Region, Kazakhstan.

The Tu-16 equipped the minelayer and torpedo-bomber regiments (MTAP – ***min****no-tor-****ped****nyy* ***avia******polk***) and maritime missile strike air regiments (MRAP – *mor****skoy*** *raketo****nos****nyy* ***avia******polk***) of the Naval Air Arm which were either components of air divisions (MTAD – ***min****no-tor****ped****naya* ***avia******divee****ziya* or MRAD – *mor****ska****ya raketo****nos****naya* ***avia******divee****ziya*) or independent. These divisions and independent regiments made up the fleet air arms of the Soviet Navy.

In 1956 the then Soviet Defence Minister Marshal Gheorgiy K Zhukov signed an order by which the Soviet Naval Air Arm was equipped with the Tu-16. These were mainly 'landlubber' (that is, not specialised naval) versions, with only a few Tu-16KS and Tu-16T aircraft designed specifically for naval service at first. It was intended that they should be flown by aircrew with some experience of overwater operations.

The plan envisaged supplying the North Fleet with 85 Tu-16s in 1956, a further 170 going to the Black Sea Fleet and Pacific Fleet the following year. The Baltic Fleet was to be the last, receiving 170 Tu-16s in 1958. Thus, over the course of three years, the Naval Air Arm would have 424 Tu-16s, just slightly less than the number supplied to the Long-Range



Aviation. In practice, things worked out somewhat differently. The first examples were in fact supplied to the Baltic Fleet. This was because in 1955 the 57th TBAD comprising two regiments of Tu-4 bombers had been transferred from the Long-Range Aviation to the Naval Air Arm where it was redesignated the 57th MTAD The division's aircrews had been well trained, but their obsolescent Tu-4 bombers were not suited to Naval Air Arm requirements. Since the division was stationed in one of the 'hottest' sectors of the Cold War, it was decided it should have priority in receiving new aircraft. Some of the Tu-4s were handed down to the Naval Air Arm training centre at Nikolayev-Kool'bakino, others converted into transports, and some high-time examples scrapped. The division's command staff, flight and ground crews were sent to factories for Tu-16 conversion training.

The Naval Air Arm took delivery of its first four Tu-16s on 1st June 1955 and on 25th June the 57th MTAD made its first training flights. The crews went through an extensive theoretical training course lasting some 400 to 500 hours, and the flight crews were subjected to a rigorous selection process. The Tu-16 was at that time considered the very latest in aviation technology and the best aircrew were chosen to fly it. In the Naval Air Arm, Tu-16 captains were strictly Pilots 1st Class (an official grade reflecting experience and expertise) with no less than 600-700 hours on the IL-28 or Tu-14, and for co-pilots the qualifying level was no less than 200 hours.

The first version to enter service with the Baltic Fleet was the baseline bomber, but with the start of production and conversion of the minelayer/torpedo-bomber version the Baltic Fleet air regiments began training on the Tu-16T. The Tu-16KS missile strike variant joined the Northern and Pacific Fleets, at first augmenting the Tu-4KS and then completely replacing it.

In June-July 1956 the first Tu-16T torpedo-bombers were supplied to the 57th MTAD, and by September nine crews of its 240th MTAP had carried out five practice torpedo attacks, two with RAT-52 practice torpedoes. After this, the Tu-16T was delivered to other naval units: the 5th MTAP was equipped: in April 1956, the 124th MTAP following suit in June, the 943rd MTAP in May 1957 and the 574th MTAP in November. Gradually, other units of the Naval Air Arm were re-equipped.

Unlike the IL-28T and Tu-14T, which could only carry two torpedoes, the Tu-16T could take up to six torpedoes. Theoretical studies indicated that the probability of hitting a surface ship when four torpedoes were launched was increased by a mere 2-3% when compared with a single-torpedo attack. Experience with the Tu-16T proved that its operational radius was significantly greater and its equipment more sophisticated than that of the IL-28T or Tu-14T; therefore, different tactics could be employed. The Tu-16T was to be used predominantly at night and in adverse weather to strike selected enemy vessels. The probability of hitting the target was to be increased by 50-100% by launching the torpedoes in a fan-like spread, although in practice this method of torpedo attack was not used.

The Good, the Bad (it's up to the reader to decide which is which) and the Double Ugly. The same *Badger-E* and the same F-4J-32-MC BuNo 158391/'436'/'NH' in an interesting formation with a Vought F-8A Crusader. US Navy

More action over the sea in a different part of the world as Tu-16SPS '91 Blue' is escorted away from its 'target' by a pair of Royal Navy British Aerospace Sea Harrier FRS.1s. The *Badger*'s tail cannon are in the fully up position to avoid incidents; it is a standing rule during such encounters that neither aircraft may use the other as a practice target. Royal Navy

The Tu-16T took part in several exercises held by all four Soviet fleets, the last of these with the Black Sea Fleet in 1959. Each of the four aircraft involved carried up to six 45-53VT torpedoes optimised for high-altitude attack. During the exercises the aircraft took off from unpaved airfields with their maximum take-off weight. The torpedoes were released in a single pass, using optical sighting. In 1960 as a result of Khrushchov's far-reaching cutbacks in Soviet air power, minelayer and torpedo-bomber units were to all intents and purposes eliminated. Almost all regiments equipped with the IL-28T (the Tu-14T was by then no longer in service) were disbanded and their aircraft decommissioned and broken up. In the Pacific Fleet alone some 400 aircraft were scrapped in a short time; such devastation had not been suffered by the Naval Air Arm even in the darkest days of the Great Patriotic War. Only the Tu-16 in its various versions remained as the sole heavy combat aircraft in naval air service.

On 20th March 1961 some of the Tu-16 naval air regiments remaining in service were redesignated naval missile strike air regiments by order of the Soviet Ministry of Defence. This reflected the actual state of affairs, since by this time they had been re-equipped to a considerable degree with the Tu-16KS. As well as this, the K-10 anti-shipping weapons system comprising the Tu-16K-10 and the K-10S ASM had begun to enter service in ever-increasing numbers. The remaining Tu-16T torpedo-bombers were almost all converted into the Tu-16S search and rescue version which stayed in Soviet Navy service for a considerable time. On 26th January 1966 the Soviet Council of Ministers authorised the transfer of six Tu-16T aircraft, apparently the last machines of their kind, to the United Arab Republic.

In the early 1960s the assimilation of the Tu-16K-10 into the Naval Air Arm got under way, and by August 1961 individual launches of the K-10S ASM had been carried out by the various fleet air arms. Soon afterwards, exercises involving groups of the new ASM carriers against convoys of ships began, and before long many naval missile strike air regiments had acquired familiarity with the K-10. Reconnaissance versions of the Tu-16 were used in land and naval exercises, and the Tu-16R was regularly used to follow the movements and exercises of NATO navies in the seas and oceans adjacent to Soviet territorial waters. A couple of Tu-16Rs were normally assigned to this in the 1960s: one fitted with an SPS-1 jammer and the other with SRS-3 ELINT sets. This was to ensure the comprehensive coverage of all the possible radar frequencies used by the NATO vessels. When the Tu-16RM-1 and Tu-16RM-2 entered Soviet Navy service they, too, were used in these operations. In the 1960s and 1970s Western aviation publications were full of photographs of Soviet Tu-16s on which the 'R and 'RM versions were shown flying over the decks of American and British aircraft carriers.

Outside the USSR, Soviet Navy Tu-16s were stationed in Vietnam. Tu-16R reconnaissance aircraft and Tu-16P ECM versions flew from Cam Ranh AB in southern Vietnam (Da Nang Province) in the 1970s and early 1980s. Studies were made at this time on the effects of the prolonged effects of the tropical climate's heat and humidity on the aircraft's airframe, equipment and electrical wiring.

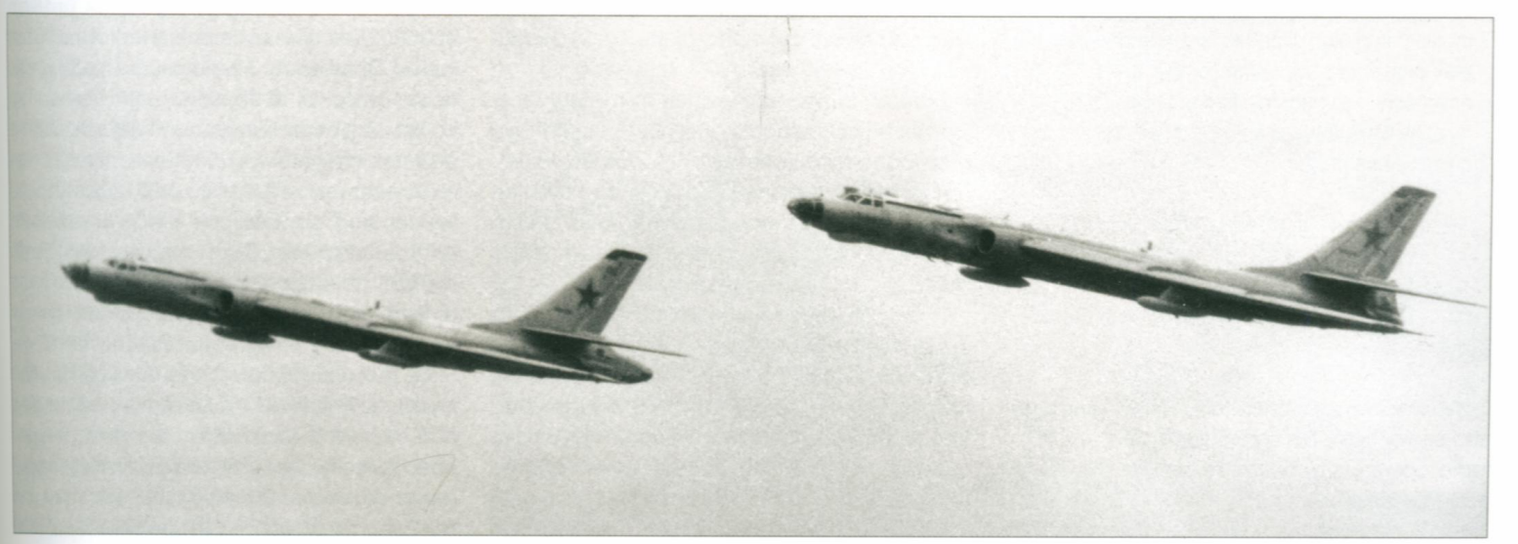
Various versions of the Tu-16 served with air regiments at different times. A regiment usually consisted of three squadrons, equipped at first with the Tu-16 and Tu-16A. When the Tu-16KS entered service, the regiment might consist solely of this version or of one Tu-16KS squadron and two squadrons of bombers. The number of versions in a regiment rose with the advent of in-flight refuelling. Normally the first two squadrons flew bomber or missile strike versions, including those with IFR capability, while the third operated tankers. With the appearance of ECM versions, these were usually flown by the third squadron, tankers by the second squadron and combat versions by the first. Sometimes the third squadron comprised tankers with ECM capability while the first two squadrons flew combat versions.

In the early 1970s the number of Tu-16 (Z) tankers in squadron service declined as the requirement for wing-to-wing refuelling changed and the aircraft reached the end of their service lives. Most of the tankers were converted into ASM carriers. A whole series of regiments lost their tankers, despite the fact that almost all combat versions of the Tu-16, as well as reconnaissance and ECM versions, were IFR-capable. One regiment at Poltava, the 226th Independent ECM Air Regiment, consisted solely of ECM versions – the Tu-16E and various versions of the Tu-16P, including several with the Cactus system. In 1986 this regiment was disbanded, leaving a single ECM squadron. Independent reconnaissance air regiments operated tankers and ECM versions in addition to reconnaissance machines. The Tu-16N tanker using the probe and drogue system equipped one squadron (the fourth) in the 200th GvTBAP (*Gvar**dey**skiy tyazhe**lo**bombardi**rov**ochnyy **avia**pol**k*** – Guards Heavy Bomber Air Regiment) based at Bobruisk and later at Belaya Tserkov'.

Naval air regiments had an even more variegated mix of aircraft. As well as the versions they had in common with the Long-Range Aviation, they also possessed purely naval air versions: the Tu-16K-10 missile carrier, the Tu-16RM-1 and Tu-16RM-2 spyplanes, the Tu-16T torpedo-bomber, the Tu-16S SAR version and the Tu-16PLO ASW version. The Tu-16T was the basic element of minelayer and torpedo-bomber units and the Tu-16K-10 of the missile strike units. With the conversion of the Tu-16T into the Tu-16S and Tu-16PLO, these latter versions were operated by ASW units.

Thus, the Tu-16 with its initial mass production and introduction into squadron service became the standard machine in both the Long-Range Aviation and Naval Air Arm. This gave rise to a number of problems associated with aircrew training and, after some years, with repair and maintenance issues.

A pair of Tu-16R *Badger-Fs* coded '02 Red' and '37 Red' make a formation flypast during the open doors day at Kubinka AB on 11th April 1992. '02 Red' is additionally equipped with a Siren' jammer in a UKhO tail fairing; missions were often flown by such mixed pairs of differently configured aircraft. Yefim Gordon



The Combat & Conversion Training Centres (TsBP i PLS – *Tsentr boye**voy** podgo**tov**ki i pere**oo**chivaniya **lyot**novo sos**tah**va*) bore the main responsibility for preparing aircrews. These centres were established in Ryazan' (Dyagilevo AB) for the Long-Range Aviation and in Nikolayev (Kool'bakino AB) for the Naval Air Arm. The centres were supplied with early production examples of the Tu-16 for aircrew training. At first the specially converted Tu-4UShS navigator trainers fitted with Tu-16 sighting and navigation equipment were used for navigator training. Several regiments had this machine and it remained in service until the early 1960s.

When units converted to the new bomber or missile carrier versions of the Tu-16, crew commanders (captains) were appointed and trained from the following personnel:

- captains of Tu-14 crews
- IL-28 pilots trained in all-weather day and visual flight rules night flying
- co-pilots who had qualified on the Tu-16 with no less than 150 hours flying time
- captains of military transport aircraft trained to a set minimum in all-weather flying by day and night.

Pilots accepted for conversion training on the Tu-16 as crew commanders had to have at least 800 hours flying time, a good or excellent grasp of piloting skills and an unblemished service record.

Tu-16 navigators were selected from the following:

- Tu-4 navigators with navigational and bombardier experience in all-weather conditions by day and fine weather conditions by night at medium and high altitudes
- co-navigators on the Tu-4 who had successfully carried practice operational flights on the Tu-16

Co-navigators were appointed from:

- Tu-4 weapons systems operators with navigational and bombardier experience by day and night at medium and high altitudes
- Tu-4 assistant navigators with navigational and bombardier experience by day and night at medium and high altitudes and who had passed their preliminary evaluation for the Tu-16
- navigators who had qualified at Long-Range Aviation operational training schools as navigator-operators

Co-pilots for the Tu-16 were chosen from:

- co-pilots on the Tu-4
- pilots who had qualified on jet aircraft at frontal bomber aviation flying schools

Defensive fire commanders (chief gunners) and senior radio operators were selected from radio operators/gunners trained for the Tu-16 and possessing a qualification no lower than second class (national service and extended service sergeant and warrant officer ranks).

Radio operators/gunners who had qualified at sergeants' schools and had been trained to meet the requirements for Radio Operator 3rd Class after two flights on the Tu-4UShS trainer were appointed as radio operators/gunners on the Tu-16. Usually these were national service sergeants (until the mid-1950s, the conscription term the Soviet Air Force was five years, during which time outstanding flight and ground crew personnel were trained).

Flying instructors were trained within the operational units under the authority of the regimental commander and the control of the divisional commander. Bombardier and navigational instruction were allocated to leading navigation personnel who had gained top grades in navigation and bomb-aiming as navigators or co-navigators.

As the number of aircraft in squadron service increased, so did the need for aircrews. The Soviet Air Force Command decided therefore to give initial training directly to aircrew cadets in military schools. The training of navigators was inaugurated at the Chelyabinsk VVAUSh and the training of pilots at the Tambov VVAUL. Those qualifying from their schools were appointed WSOs and assistants to crew commanders when they were posted to an air regiment. After obtaining a set standard, they became navigators and crew commanders. The centres in Ryazan' (43rd TsBP i PLS) and Nikolaev (33rd TsBP i PLS) specialised in the training of commanders, and subsequently they trained captains for other types of aircraft in service with the DA and AVMF – the Tu-22, Tu-95 and Tu-22M.

The Tu-124Sh-1 was a version of the Tu-124V short-haul airliner specially modified for navigator training in the Long-Range Aviation. It was fitted with the bomb-aiming and flight instrumentation of the bomber, and later the missile strike versions, of the Tu-16. They were used in the training regiments at the Chelyabinsk VVAUSh and also for training pilots at the Tambov VVAUL, since the aircraft was similar to the Tu-16 in its handling characteristics. Later these two schools, the most important ones for training navigators and pilots for the Long-Range Aviation, were supplied with actual examples of the Tu-16 to optimise aircrew training.

Ground crews were trained in military aviation technical schools (VATU – *vo**yen**noye aviatsi**on**no-tekh**nich**eskye oo**chil**ischche*). Specialists on airframes, engines and aviation equipment were trained at the Irkutsk VATU, those specialising in armament at the Achinsk VATU, and radar specialists in Tambov.

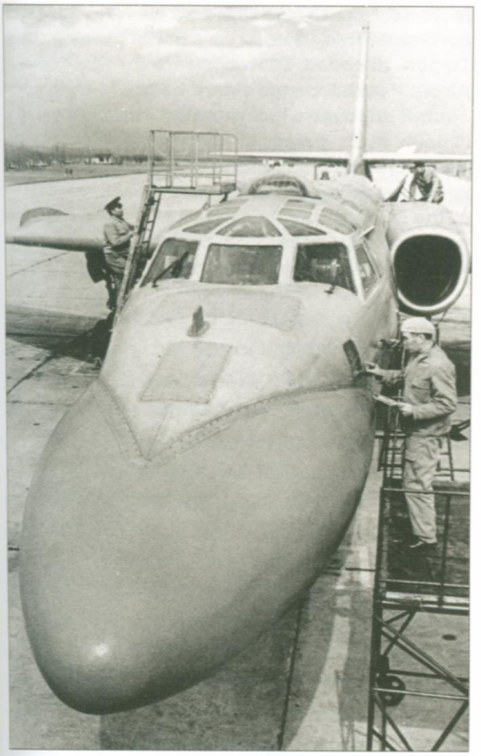
In this way the requirement for qualified personnel for the Long-Range Aviation and Naval Air Arm was met. The repair and maintenance problems were met by the DA's aircraft overhaul plants in Khabarovsk, Orsha and Belaya Tserkov', while AVMF aircraft were repaired and refurbished in Nikolayev and Artyom (near Vladivostok). Aircraft repair factories in Ryazan', Tartu, Baranovichi and Staraya Roossa were also involved in the repair and maintenance of the Tu-16.

As well as repairs, the aircraft repair plants (ARZ) carried out more far-reaching work. In the 1960s series production of the Tu-16 came to an end and later types of aircraft, the Tu-22 and Tu-95, were built at their former production factories. The ARZs, therefore, bore responsibility for carrying out modifications to those Tu-16s still in squadron service. During repair and maintenance, aircraft were re-equipped. In this way the missile carriers for the K-11, K-16, K-26 and K-26P, the Tu-16RM-1 and Tu-16RM-2 reconnaissance versions, the ECM versions with Azaliya, Ficus and Cactus jammers, the Tu-16N tanker, the target drone launchers, the M-16 target drones and other versions of the Tu-16 came into being. Repair and maintenance of the Tu-16 at Belaya Tserkov' continued until 1985, at Orsha until 1980 and at Khabarovsk until 1992 – in which year all further work on re-equipping and overhauling the Tu-16 ended.

In the late 1980s and early 1990s the Tu-16's designated service life was 35 years, but the decision was then taken to extend this to 38 years. In 1990-1991 a number of machines dating from 1955-56 were refurbished and modified as target drones at ARZ-12 at Khabarovsk The last conversion work took place in 1992 when five Tu-16s built in 1957 were modified as target drones. After the dissolution of the USSR, there were no funds available to maintain old hardware, let alone replace it.

The Tupolev OKB kept an eye on all Tu-16 aircraft during the first phase of their squadron service. The slightest fault with the airframe or its systems, or with its equipment, was rectified and, if necessary, the findings applied to aircraft in service and on the production line. The initial period of squadron service was almost trouble-free, and the few accidents that did occur were investigated and the causes discovered; measures were then taken to ensure that they did not reoccur in future. Some of the typical and serious accidents are detailed below.

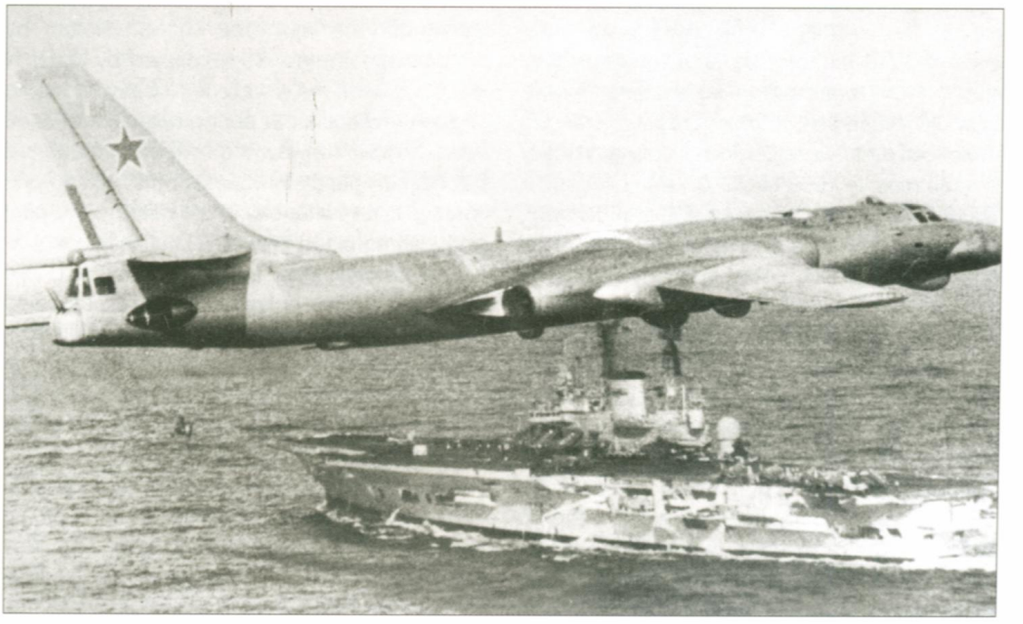
The first loss of an operational Tu-16 took place even before the official acceptance of the aircraft into service. On 6th April 1954 Tu-16 c/n 4200202 (tactical code unknown) of the 402nd Heavy Bomber Air Regiment crashed near its home base of Balbasovo near Orsha. The cause was an uncommanded deflection of the elevator trim tab. On 30th January 1955 the nose gear unit of Tu-16 c/n 4201302 collapsed on landing at the GK NII VVS airfield in Akhtoobinsk. On 19th August 1955 Tu-16 'No 802' (that is, c/n 4200802?) crashed at an airfield near Poltava when the AP-5-2M autopilot failed. On 18th April 1956 Tu-16K-10 c/n 5202 (full c/n unknown) was damaged beyond repair at Priluki AB. A previous hard landing had caused a weakness in the lower stringers near frame18, and the forward fuselage broke away at frame 20 when the pilot put the machine down short of the runway.



Above: **This view clearly shows the characteristic V-shaped joint line between the Tu-16K-10's 'duck bill' radome and the metal portion of the nose; note the dorsal access panels.** Sergey and Dmitriy Komissarov archive

Above right: **Maintenance work is under way on a Kazan'-built Tu-16K-10 coded '44 Red'; note the panel on the port side of the nose removed for access to the radar set of the YeN radar.** Yefim Gordon archive

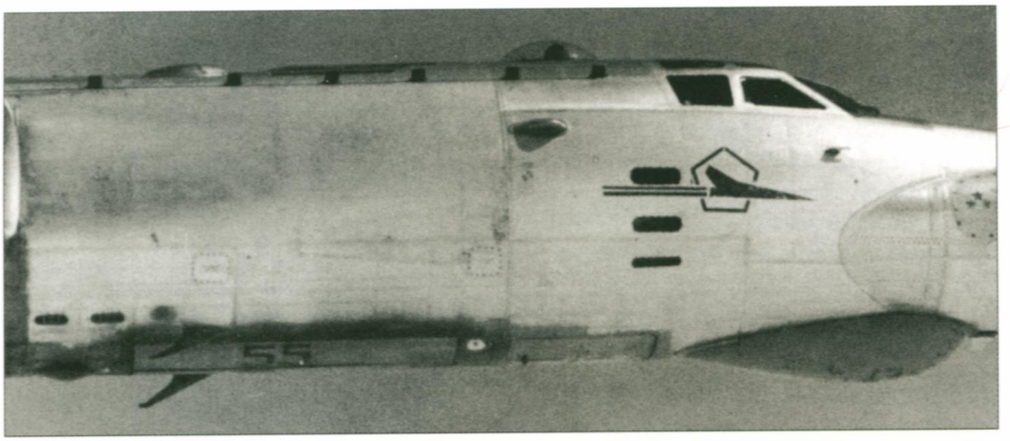
Right: **Wearing life jackets and the white-topped caps issued to Soviet Navy officers, the crew of a Tu-16K-10 parked in a revetment with a concrete jet blast deflector discusses an impending mission.** Sergey and Dmitriy Komissarov archive



Below right: **A Tu-16RM-1 or Tu-16RM-2 passes over the aircraft carrier HMS *Ark Royal*, showing the ventral radomes.** *Jane's All the World's Aircraft*

On some occasions, an order given by command staff on the ground was the potential cause of an accident. Before the 1954 May Day flypast test-pilot M A Nyukhtikov was ordered to descend after passing over the History Museum at the entrance to Red Square and pass the Lenin Mausoleum at the same height as the saluting stand before climbing away steeply over St Basil's Cathedral. Nyukhtikov saw clearly how impossible this was; yet he had no alternative but to obey the order. He resolved the dilemma by losing height very slightly and then accelerating away at around 1,000km/h with a roar of engines. The effect was so dramatic that no one remembered to ask why the pilot had not carried out his order to the letter.

Air traffic control incompetence was sometimes to blame for accidents. Thus on 24th August 1981 Tu-16K c/n 6203106 (tactical code and exact version unknown) belonging to the 30th VA/55th TBAD/303rd TBAP crashed near



In Soviet times great care was taken to maintain serviceability and keep up combat training. This Tu-16K-10 coded '55 Red' wears the 'Excellent Aircraft' maintenance award badge (a stylised aircraft silhouette incorporated into the Soviet 'Quality mark' pentagon) and three 'kill' stars marking successful missile launches against practice targets. Note the very dirty underside of the nose, probably a result of minute rubber particles separating from the nosewheel tyres on touchdown. Yefim Gordon archive

Zavitinsk after colliding with an Aeroflot/Far Eastern Civil Aviation Directorate An-24RV twin-turboprop airliner registered CCCP-46653 (c/n 47309204). The collision, which occurred in thick overcast (the pilots did not see each other's aircraft and were unable to take evasive action), was due to poor interaction between civil and military ATC authorities which had (unbeknownst to each other) cleared both aircraft to use the same flight level. The bomber's crew perished; so did all occupants of the An-24 except one. Incredibly, a female passenger survived a fall from high altitude after being thrown clear of the aircraft as it disintegrated; fortuitously, she landed in a deep snowdrift, suffering nothing worse than bruises! Interestingly, at the time of the crash the Tu-16 was using the ATC callsign CCCP-07514; in reality this registration belonged to an An-2TP utility aircraft (c/n 1G 15242) built in December 1973.

Test pilots managed to save the Tu-16 on more than one occasion. In the mid-1950s a test crew from plant No 1 in Kuibyshev was ordered to determine the maximum permissible G load for a Tu-16 bomber. At the time, the methodology for this lagged behind the skills in handling the aircraft itself and on reaching the prescribed G load the aircraft stalled, entering a spin. The commander ejected ahead of the other crew members, but was killed immediately afterwards when he was struck by a hatch cover released by another member of the crew as he exited the aircraft The co-pilot, Aleksandr Kazakov, managed to recover from the spin, exceeding all speed and G load limits in the process. He had thus unwittingly tested the airframe's strength.

Special tests were carried out on a number of examples. In 1956 Lt Col G Yaglov landed a Tu-16 for the first time on an unpaved runway, after which take-offs and landings were made on a regular basis, using sparsely equipped auxiliary airstrips in the tundra and on the Arctic ice without any adverse consequences.

In the mid-1950s only a few airfields in the Soviet Arctic, such as Amderma, Severomorsk, Chekurovka, Wrangel Island and one or two others, were suitable for heavy bombers. A special operations group was formed in the early 1960s to co-ordinate the work of the 16 airfields in the High North. In addition to these, temporary airfields with hard-packed earth runways and ice runways were set up, although these were not intended for heavy bomber operations; on take-off and landing, clods of earth or chunks of ice could be ingested by the aircraft's engines, damaging them.

In the second half of the 1950s it was decided to use ice floe airfields in the Arctic to increase the operational capabilities of the Long-Range Aviation. This turned out to be no easy matter since the landing weight of loaded strategic bombers was around 70-95 tonnes. While the bomber's weight could not break through the ice, which was many metres thick, the aircraft could skid off the runway when it braked on landing. Added to this, the ice's high salt content made its surface friable, and the vibration induced on take-off and landing was so violent that it was impossible to read the instruments properly.

In April 1958 A Krotov, Commander of the 52nd TBAP, was ordered to prepare his three best aircrews for Arctic flights, including landing on an *ad hoc* ice airstrip in poor weather conditions. Colonel A Alekhnovich, a Hero of the Soviet Union and Vice-Commander of the 45th TBAD to which the 52nd TBAP was subordinated, was appointed to head the mission. Shortly afterwards more detailed orders were issued. Two aircraft (a Tu-16 and a Tu-95) were to fly towards the North Pole and effect a landing on ice in the vicinity of the SP-6 drifting polar research station; a third aircraft was to remain at Tiksi until further notice. The two aircraft landed safely on the ice. The Tu-16 piloted by Alekhnovich and the Tu-95 piloted by Major N Bazarnyy were the world's first heavy aircraft to land on Arctic ice. But during take-off the Tu-16 veered off the runway; the take-off was aborted but the bomber's starboard wing struck a Polar Aviation IL-14 transport parked nearby – the pilot only just managed to avert a fatal accident.

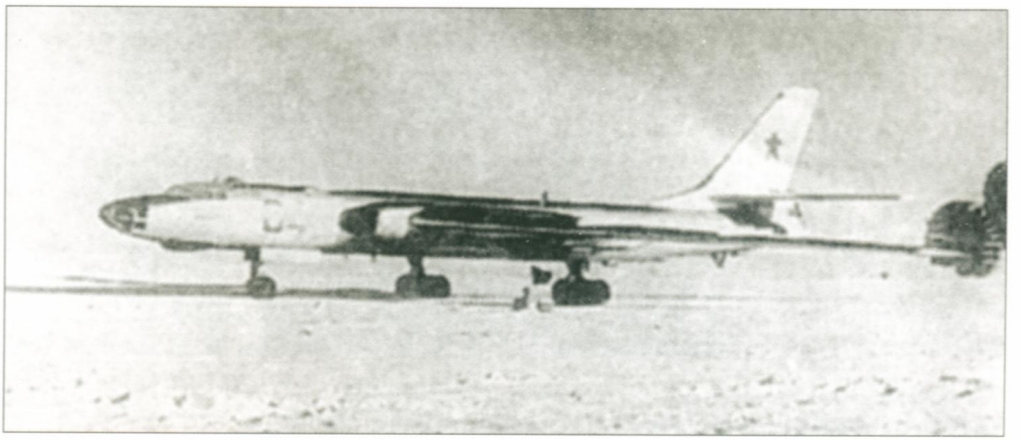
Both aircraft were seriously damaged. The repair crew which arrived two weeks later could not repair the Tu-16 on site – in Arctic field conditions the job proved to be beyond their capabilities. Nor could the machine could be dumped into the ocean, as the ice floe was ringed by ice hummocks some 16 to 20 metres high.

News of the accident was kept secret; officially the aircraft was 'undergoing repair on the mainland'. For almost a year, from 23rd May 1958 until 16th April 1959, the Tu-16 drifted through the Arctic Ocean, accompanied by the staff of the polar station and the technician left to guard it. Meanwhile, pieces kept breaking away from the ice floe so that by April 1959 it was only half its original size. It was only when the winds and currents began to carry the polar station towards the Greenland Sea that the decision was taken to destroy the aircraft after all salvageable equipment and engines had been removed. As early as September 1958 the Tu-16 had been spotted by a Royal Canadian Air Force reconnaissance aircraft and the Western press began to make noises about the setting up of Soviet strategic bases on neutral territory relatively close to the American continent.

While stripping the Tu-16 down, the technical crew had to use an LAS-5M inflatable dinghy to reach it due to the melting ice. Once the engines and equipment had been recovered, the airframe was doused with kerosene and set alight. The personnel from the drifting polar station, the technician and the dismantling crew were evacuated to the mainland. For his 'lengthy secondment' technician R Kagilov was given a substantial reward and leave. After this, no more landings by the Tu-16 were made on ice strips in the Arctic, although for various reasons some unplanned landings on the ice did take place.

Altogether between 1954 and 1956 ten Tu-16 were lost in fatal and non-fatal crashes. The worst attrition in the Tu-16's service career was between 1957 and 1960 when about ten machines were lost each year. Then the accident rate fell sharply; in the 'sixties and 'seventies the average annual attrition was one or two. On 15th July 1964 a Tu-16R crew reported sighting an American carrier group 200km to the east of the Japanese coast. After this, nothing more was heard from the aircraft; there were no survivors among the crew of seven. On 25th May 1968 another Tu-16R reconnaissance aircraft was lost near Newfoundland after overflying the aircraft carrier USS *Essex*. There was a suspicion that the aircraft had been shot down by the US Navy air defences immediately after reporting the location of an American destroyer, but this allegation was refuted by the Americans. Wreckage from the aircraft collected during the ensuing search and rescue operation was transferred to the Soviet destroyer with the tactical number '311'.

By the end of 1981, 106 examples of the Tu-16 had been lost for various reasons, including 72 Air Force (DA) aircraft and 34 Navy aircraft. In the early years the share of fatal and non-fatal accidents caused by hardware fail-



A Tu-16 coded '04 Red' deploys its brake parachutes after landing on a ice runway near the North Pole. *Krasnaya Zvezda*

ures was fairly high; as the bomber's assemblies and components were developed and improved this was reduced to almost zero, and it was the errors of the flight and ground crews that became the major culprits.

Not all such incidents ended badly for the Tu-16, though. In the early 1980s a Tu-16 on patrol over the Atlantic was intercepted by three of the latest American carrier-based fighters, the McDonnell Douglas F/A-18A Hornet. Trying to scare the Soviet aircraft off its intended course, the fighters performed dangerous manoeuvres, including head-on passes. This cat-and-mouse game ended in tragedy when two of the 'attackers' collided directly above the Tu-16 and exploded; one pilot was killed, the other managed to eject. The flying debris damaged the Tu-16 but managed to limp back to base thanks to the courage and skill of its crew.

In the course of its service career the Tu-16 was called upon to carry some unusual civilian passengers. In 1957, when it was vital to summon the first secretaries of the regional and district Communist party committees for an extraordinary full party meeting to support Nikita S Khrushchov against an 'anti-Communist opposition group' within the Soviet government, Gheorgiy K Zhukov used his power as Defence Minister to arrange for the necessary party bosses to be flown in on Tu-16 bombers. Khrushchov was thereby enabled to convoke a plenum quickly and gain the necessary number of votes. In this way the Tu-16 played a crucial part in the power struggle among the political leaders of the USSR in the second half of the 1950s.

'Cherry picker' trucks with powered telescopic ladders were used for maintenance of the tail unit. Yefim Gordon archive

The Tu-16 in its various versions formed the backbone of the Long-Range Aviation for a considerable time. From the late 1950s, when the Tu-22 long-range bomber entered service, several DA regiments at Baranovichi, Machulishchi, Zyabrovka, Ozyornoe and Nezhin and naval air regiments at Saki, Ostrov and Kaliningrad began converting to the new type. However, the Tu-22 was not a completely successful aircraft, accident-prone and complicated to operate. Production of the Tu-22 was terminated at the end of the 1960s. The air regiment at Vozdvizhensk took delivery of several new machines initially, but then passed them on to other regiments and reverted to the Tu-16.

The service debut of the Tu-22 in the 1960s hardly diminished the role of the Tu-16 in the nation's defence. Firstly, there were far fewer regiments equipped with the Tu-22 than with the Tu-16; secondly, the Tu-16 was the more versatile machine with a significantly wider range of applications; thirdly, at its subsonic cruising speed the Tu-22 had no advantages in performance over the Tu-16; finally, the K-26 weapons system with the KSR-5 missile was at least equal, and in some aspects superior, to the K-22 system.

During the 1970s more modern types of bombers and missile carriers, the Tu-22M1, Tu-22M2 and later the Tu-22M3, began to enter service with the DA and the AVMF. In 1972 the air regiment at Poltava was the first to get the Tu-22M, followed by the unit at Sol'tsy, both regiments at Belaya Tserkov', the regiment at Shaikovka and so on. In the Naval Air Arm the regiments at Nikolayev, Sovetskaya Gavan', Bykhov and the like were re-equipped. The regiment at Priluki was re-equipped with this type in the 1980s. But even when full-scale production and delivery of the Tu-22M2 and Tu-22M3 got under way in Kazan', the Tu-16 remained in service with the overwhelming majority of Long-Range Aviation and Naval Air Arm regiments. The numbers of the different versions of the Tu-16 in service with the DA as of 1st January 1979 are given in the table below.

About as many Tu-16 (of which 209 were missile strike aircraft) remained in service with the Naval Air Arm .

At the end of 1981 the Long-Range Aviation had 487 Tu-16 and the Naval Air Arm 474. One hundred and fifty-six were in service with other elements of the Soviet Armed Forces and the defence industry. MAP documents also listed 106 examples as 'not current' by then (this included both aircraft written off due to technical condition and accident attrition). The remaining machines, apart from those exported, do not appear in the statistics for some reason.

The scales began to tip in favour of the Tu-22M in the 'eighties after the Tu-16 had been taken out of service in large numbers. At the end of 1990 there were 173 Tu-16s in the European part of the USSR, of which 81 were in Long-Range Aviation service and 92 in Naval Air Arm service. The DA Tu-16 served with the 251st Air Training Regiment (UAP – *oo**cheb**nyy **avia**polk*) at Belaya Tserkov' (40 aircraft), the 260th TBAP based at Stryy (23 aircraft) and the 200th TBAP at Bobruisk (18 tankers). The Black Sea Fleet's 540th MRAP based at Nikolayev-Kul'bakino in the Ukraine had 20 machines, and there were 38 further examples, mainly Tu-16K-10-26s, operating from airfields in the Crimea. In the North Fleet in 1991 there were four examples in service with the 924th Air Regiment at Olen'ya AB and 30 more with the regiment at Severomorsk-3 AB. There were also

Year Built	Tu-16	Tu-16A	Tu-16Z	Tu-16N	Tu-16R	Tu-16KSR	Tu-16 Yolka	Tu-16P Buket
1954	–	3	–	–	–	17	–	–
1955	8	5	5	–	–	99	8	25
1956	4	9	15	2	–	52	27	44
1957	10	21	–	8	14	38	4	27
1958	1	–	–	–	8	5	29	8
Total	23	38	20	10	22	211	68	104
Overall Total	**496**							

The end of the road. Ignominiously dumped, the severed flightdeck sections at the Russian Navy's Ostrov AB near Pskov testify that another 12 Tu-16s have gone the way of all metal. The second aircraft in the row was c/n 7203820 and was equipped with individual protection ECM gear (note the traces of the nose thimble radome); the seventh aircraft from right was a Tu-16K-11-16. Yefim Gordon

The savagely hacked rear fuselage of another Tu-16 at Ostrov AB, with the main gear bogies (probably belonging to the same machine) visible beyond. The number on the remains serves to make sure all parts are accounted for and nothing is stolen! Yefim Gordon

some 60 machines in service in the Far East with the Pacific Fleet Air Arm. After 1991 almost all surviving Tu-16 were withdrawn from use, a handful remaining with the Naval Air Arm, GK NII VVS and LII. From the close of 1995 the Tu-16 virtually ceased to operate in the Ukraine, although 49 examples were stored at air bases and 19 others continued in serve as trainers with the 540th Air Regiment. By this time not a single active Tu-16 remained in Belarus'.

The last Long-Range Aviation regiment to fly the Tu-16 was the Independent Long-Range Reconnaissance Air Regiment based at Spassk-Dal'niy. After the regiment had re-equipped with the Tu-22M, the remaining reconnaissance and ECM versions were ferried to Belaya Tserkov' AB for mothballing. Sadly, no money could be sourced for even placing the aircraft in storage; the remaining Tu-16s in Russia were scrapped.

At the Chagan storage depot in the Semipalatinsk Region, some 100 examples of various versions of the Tu-16 stood rusting away for a long time. After their 'privatisation' by Kazakhstan, they soon became non-airworthy. A similar fate befell the Ukrainian machines after the disintegration of the USSR.

In Russia the Tu-16 was officially retired from service in 1994, although there were examples of the Tu-16K-10 family built in 1963 which had not reached the end of their 35 year service life. By this time the Tupolev OKB had ceased to work on the Tu-16.

For a long time the two 'Cyclone' weather research aircraft stood unused. At Zhukovskiy only a single Tu-16LL was kept in flying condition. Apparently this was the last flying example of the Tu-16 on Russian soil.

The Tu-16 in Action

In addition to the many exercises, reconnaissance flights and other special duties on behalf of the Soviet Armed Forces, the Tu-16 also took part in actual combat in other countries.

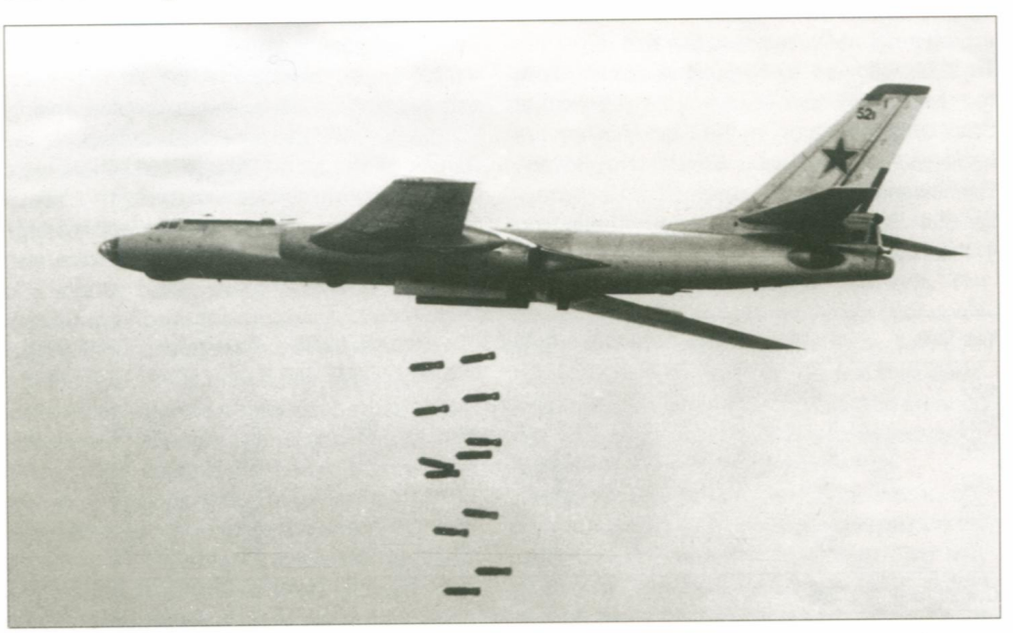
In August 1968 the Tu-16P was employed during the Soviet invasion of Czechoslovakia, providing ECM cover during the deployment of tactical aviation and military air transport formations on the day that Warsaw Pact forces intervened. The only real war in which Soviet Air Force Tu-16s took part was the Afghan War. The type was used in bombing raids against Mujahideen bases and concentrations when, apart from attacking insurgent positions, it carried out bombing raids in the vicinity of the towns of Herat and Kandahar which were controlled by the rebels.

The bomber versions were used on the largest scale – the Tu-16A, Tu-16KSR-2-5 and Tu-16KSR-2-5-11 bomber/missile strike aircraft, as well as Tu-16R reconnaissance aircraft and the Tu-16P ECM version. Other variants rarely saw action in Afghanistan. A typical bomb load consisted of 12 FAB-500 bombs, sometimes, in special circumstances, larger or smaller calibre bombs (250-kg, 1,000-kg, 3,000-kg, 5,000-kg and even 9,000-kg bombs of the M-54 or M-46 series) were used. On occasion this was because the bombs were nearing the end of their storage life and had to be disposed of.

Apart from the Tu-16, other Long-Range Aviation units armed with the Tu-22R and Tu-22M3 took part in operations over Afghanistan. The 'veteran' Tu-16 was used in this conflict primarily because of its ability to carry a 9,000-kg bomb. The FAB-9000 could give the terrain a 'working over', levelling hills and high ground and producing craters so that the terrain resembled a lunar landscape.

Bombing raids were carried out during daylight hours, using optical bombsights. The bombers were supported by Tu-16P ECM aircraft with Buket sets to jam the Pakistani air defence radars, and also to counter the Pakistani Air Force fighters which often intervened and posed a serious threat to the Soviet bombers.

The aircraft flew from Soviet territory in small groups: a flight of three or four or a squadron of eight to ten machines. Only experienced aircrews trained in formation flying were chosen, and the overall standard for aircraft commanders and navigators had to be no lower than Pilot 2nd Class.



A Tu-16 drops a stick of bombs; the aircraft appears to be equipped with the SRS-1 SIGINT system (note the small blister ahead of the bomb bay). Yefim Gordon archive

Bombing operations over Afghan territory were carried out by almost all air regiments operating the Tu-16 in the European part of the USSR. The most active was the Belaya Tserkov' regiment. The missions were flown from Central Asian airfields, particularly from Maryy in Turkmenia and Karshi in Uzbekistan. From here the crews made training flights over the desert and practised bombing with the aid of LORAN.

One of the biggest raids on the Mujahideen base took place on 22nd April 1984. Twenty-four Tu-16KSR-2-5, each carrying either 40 or 25 FAB-250 HE bombs, took part in the raid. The target was located in a mountain valley near Kandahar. Two squadrons from the regiment at Bobruisk and one squadron from the regiment at Belaya Tsekov' were involved; the aircraft flew in echelon formation, one squadron behind the other. The first eight machines were led by Colonel Pachin, Commander of the 200th GvTBAP.

At first it was planned to deliver the bombs from an altitude of 6,000m, but the formation flew into cloud on approach to the target, which created the danger of collision since the aircraft were flying in close formation. Under these conditions, the group leader took the decision to climb and the target was approached at an altitude between 8,700 and 9,500m. The lack of visibility meant that the bombing had to be carried out using LORAN. The first eight machines were greeted with anti-aircraft fire, although they were out of the air defences' range. The bombs dropped by the leading squadron neutralised the anti-aircraft defences, so that the other two squadrons carried out their attack unmolested. Gaps in the cloud showed explosions testifying to the accuracy of the bombing. On average each squadron dropped 250 bombs into an area measuring 200 by 300m.

After the Tu-16s had done their bit, the base was hit by Sukhoi Su-24 tactical bombers and Su-25 ground attack aircraft. As the Tu-16, Su-24 and Su-25 formations attacked from different directions, the raid was unofficially dubbed a 'star strike' (***zvyozd**nyy na**lyot*** – an old term for such a tactic dating back to the late 1920s).

After their return to the airfield at Karshi, the Tu-16KSR-2-5s were refuelled and rearmed, and a repeat raid was carried out four hours later. This time each group of aircraft had its own individual objectives in destroying the remains of the Mujahideen gang who were fleeing in all directions from the devastated area. The bombs were dropped from between 1,500 and 2,000m with the enemy clearly visible against the snowy background.

Post-attack reconnaissance was made with the assistance of the Tu-16R; photographs showed clearly that the air group had carried out their mission with distinction.

The Tu-16 was built in China as the H-6. Here, three substantially complete H-6s share the final assembly shop at Xian with two Y7H (licence-built Antonov An-26) transports. *China Aircraft*

Tu-16 Operators Abroad

CHINA (Chinese Tu-16 Versions)

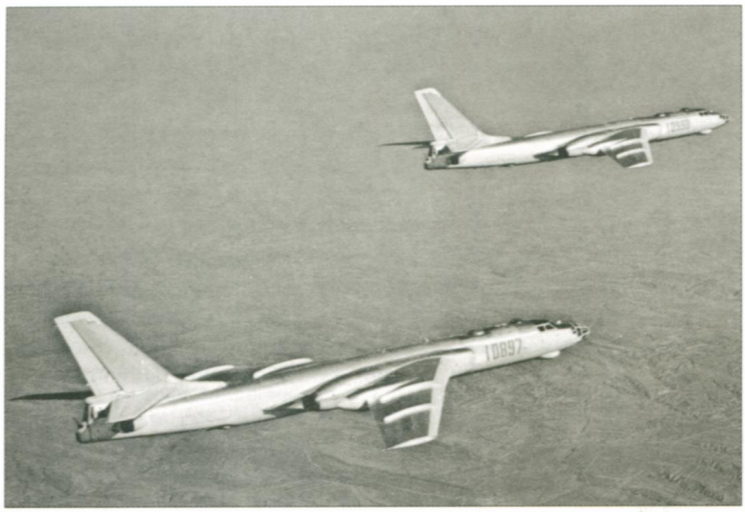
Xian H-6 Strategic Bomber

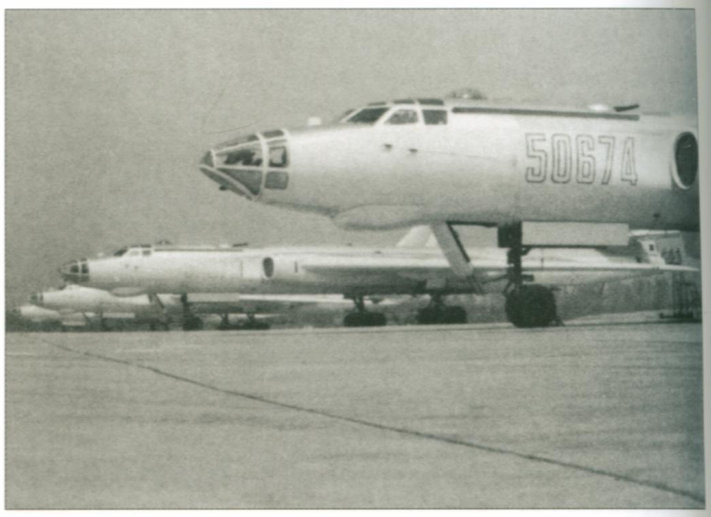
In early 1956 a Sino-Soviet agreement was reached for the licence production, with Soviet assistance, of the IL-28 and Tu-16 bombers in the People's Republic of China (PRC). The licence agreement for manufacture of the Tu-16 was signed in September 1957. Under the terms of this, China received two production Tu-16 bombers and a further aircraft in the form of a completely knocked-down (CKD) kit, essential for mastering the assembly of the first examples, from plant No 22 in Kazan' together with the necessary technical documentation.

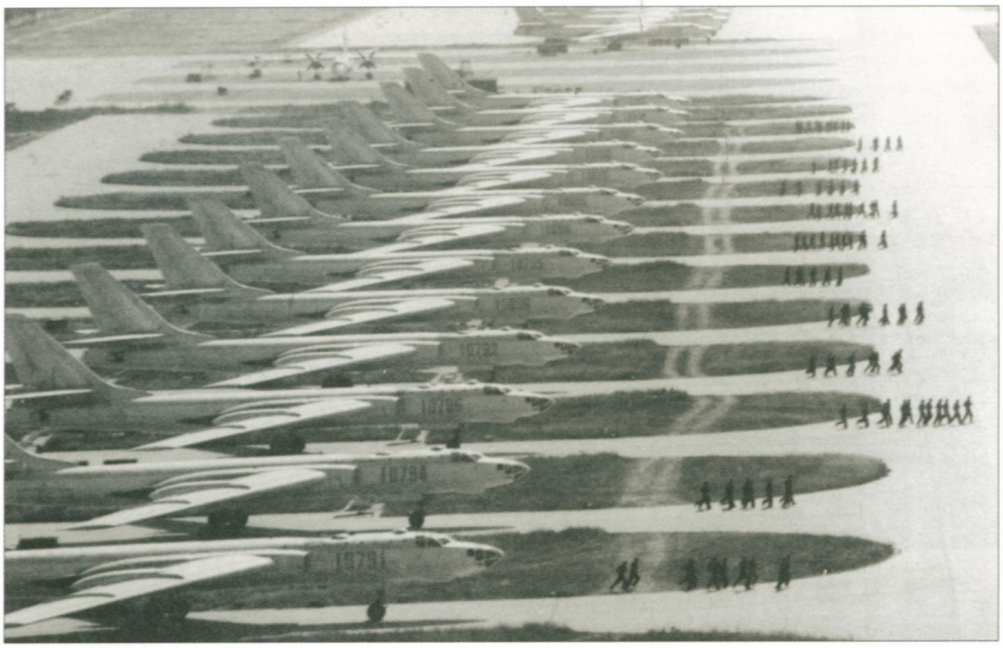
In 1959 the decision was taken to begin licence production on China, and in the same year a large technical team left the USSR for China to assist in setting up series production. It remained in China until the autumn of 1960.

The Chinese allocated two factories in Harbin and Xian (sometimes spelled Xi'an) for Tu-16 production. In May 1959 the assembly of a Tu-16 from the parts supplied from Kazan' began in Harbin (the Harbin factory received assistance in the form of 200 qualified workers seconded from the aircraft factory at Shenyang which was producing MiG fighters under

'10794 Blue', a standard People's Liberation Army Air Force nuclear-capable H-6A. Like the genuine Tu-16A, it has a 'nuclear' colour scheme with white undersurfaces. *China Aircraft*





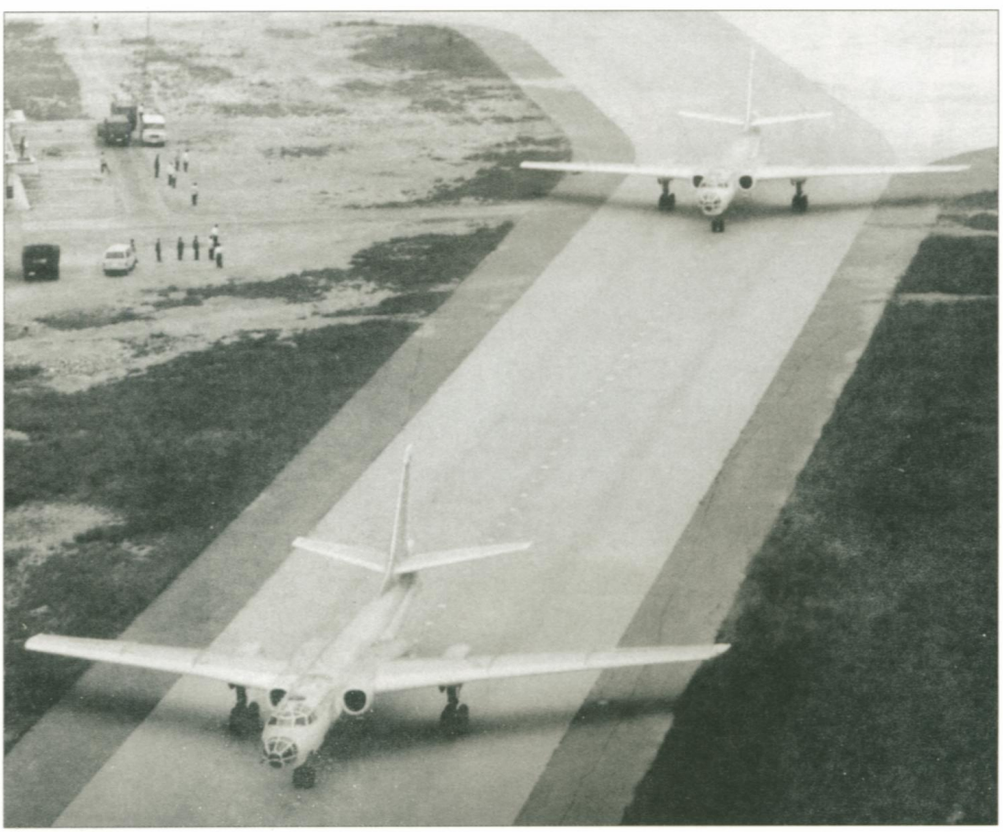


Above left: **A pair of H-6As ('10897 Blue' and '10990 Blue') fly in echelon starboard formation high above mainland China. The first two digits of the serial may be a code denoting one of China's eight defence districts, the fourth digit is a unit code, while the third and fifth digits make up the individual number of the aircraft in the unit; thus, '10897 Blue' and '10990 Blue' are the 87th and 90th aircraft in their Heavy Bomber Division. Note the low-visibility presentation of the 'stars and bars' national insignia.** *China Aircraft*

Above right: **More H-6As, including '50674 Blue outline' and '50675 Blue outline', at a PLAAF base; the low-visibility serials are noteworthy. The entrance hatches are kept open to save time in the event of a 'hot scramble'.** *China Aircraft*

An impressive line-up of at least 17 PLAAF H-6As parked at a Chinese airbase, with a Y7H in between. *China Aircraft*

Two H-6As taxi out for a sortie. *China Aircraft*



Photographs on the opposite page:

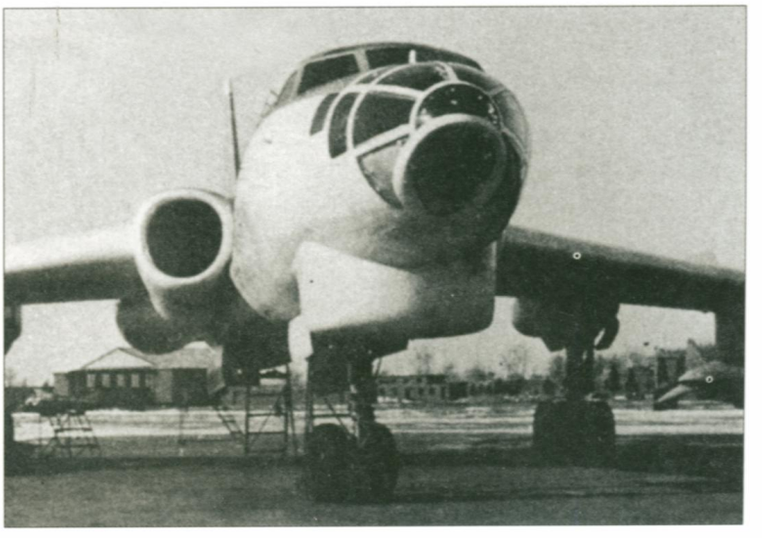
An H-6D at the factory airfield in Xian, with a Y7 airliner (licence-built An-24B) visible beyond. The two C-601 Silkworm ASMs are clearly visible under the wings. Note how much longer the missile pylons are than those of the Soviet missile-toting versions. *China Aircraft*

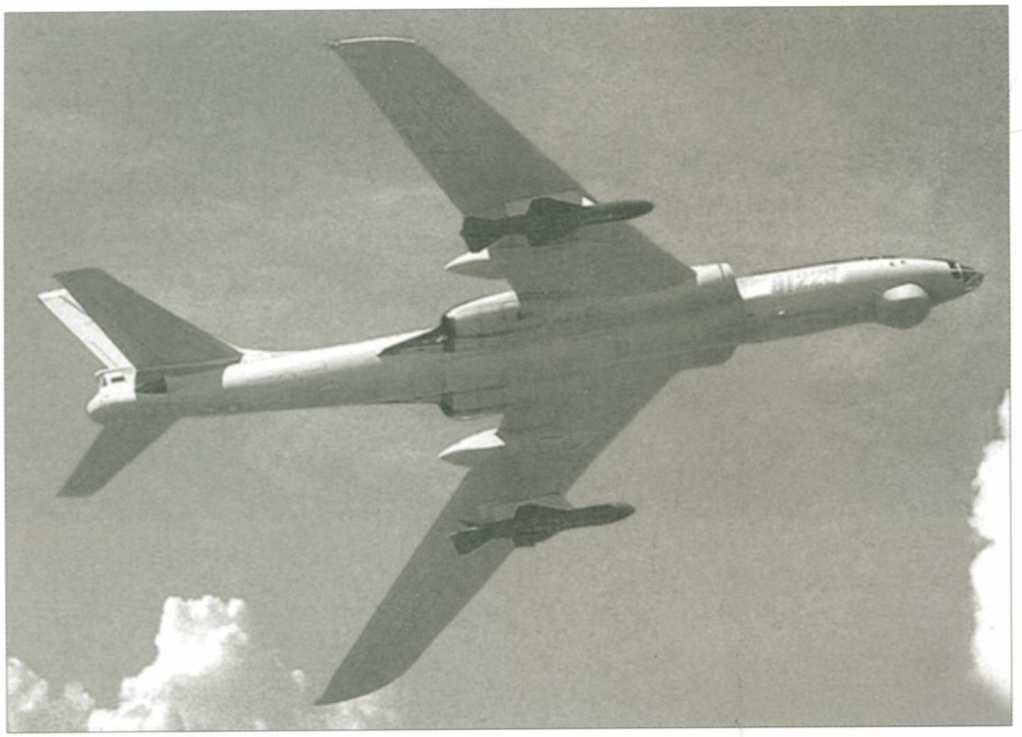
An operational camouflaged H-6D with two C-601 missiles. The missile pylons are *not* bifurcated; quite simply, their leading edges are painted green while the rest is left unpainted, creating this eerie impression. *China Aircraft*

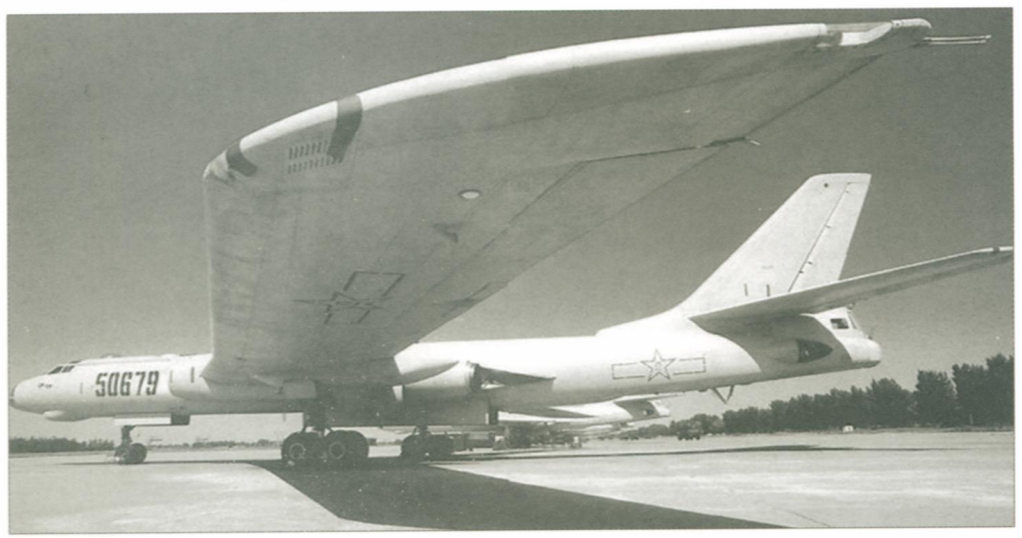
An air-to-air view of an H-6D serialled '61225 Blue outline', showing the characteristic triple tail surfaces of the C-601 missiles. Interestingly, this one sports a 'nuclear' colour scheme more typical of the H-6A. *China Aircraft*

Bottom left: **This factory-fresh H-6D displays an unusual dark green colour scheme intended to make the aircraft less conspicuous over the sea. Note the non-standard aerial ahead of the flightdeck windscreen.** *China Aircraft*

Bottom right: **Another view of the H-6D, showing to advantage the much-enlarged flat-bottomed radome.** *Jane's All the World's Aircraft*







licence). The first Chinese Tu-16 assembled from Soviet-supplied parts made its maiden flight on 27th September 1959 and was handed over to the People's Liberation Army Air Force (PLAAF, or *Chung-kuo Shen Min Taie-Fang-Tsun Pu-tai*) that December.

In 1958 the large aircraft factory at Xian was completed, and to assist in Tu-16 production there 1,040 skilled technical and engineering staff and 1,697 other workers were transferred from Shenyang. In 1961 the Chinese leaders decided to concentrate all work on the licence-built Tu-16 at the Xian factory. The Chinese have a habit of giving local designations to the aircraft they build under licence, and the Tu-16 was known locally as the Hongzhaji-6 (Bomber Type 6), often shortened to Hong-6 or H-6.

Even before production of the H-6 had been fully implemented, the modification of a Tu-16 assembled from Soviet parts into a carrier for the Chinese atomic bomb started at Xian. The bomb bay and bomb release system were modified, a thermal stabilisation system for nuclear weapons fitted in the bomb bay, and the necessary monitoring and recording equipment for nuclear testing installed. To all intents and purposes this aircraft was the counterpart of the Soviet Tu-16A. On 14th May 1966 this aircraft carried out the successful testing of the third Chinese A-bomb over a range in western China.

Work on preparing the jigs for the series production of the H-6 began in 1964. In 1966 the first airframe assembled from Chinese parts and intended for static tests was finished. On 24th December 1968 the first production H-6 bomber completely built in China (with Chinese 'Wopen-8' engines – licence-built versions of the Soviet RD-3M-500 with a take-off thrust of 9,520kg) made its first flight. The crew were commanded by test-pilot Li Yu-Anui. After this, full-scale production of the H-6 in China got under way.

The reason that it took so long to establish the H-6 in production in China was a result of the disorganisation of their aircraft industry caused by the spread of the Great Chinese Cultural Revolution. In all, up to 1987, the London Institute for Strategic Studies estimates that something like 120 H-6 bombers in various versions were built in China. The standard version was an analogue of the Soviet Tu-16A and intended to carry conventional and nuclear bombs.

H-6A

In 1970 work began on designing a new generation integrated navigational and bomb-aiming system for the H-6 with a high degree of automation. The system comprised an onboard computer, automatic plotter, Doppler navigational radar, a more developed autopilot and a new bomb-aiming radar.

Tests of the H-6A fitted with the new system were held between 1975 and 1981. The system, in many of its essentials, was based on Western components and whatever other parts were available. Production of the new version with the updated avionics began in 1982. The aircraft could carry conventional and nuclear bombs,

A Chinese-built flatbed lorry with a crane tows a whole train of trailers loaded with general-purpose bombs due to be loaded in a squadron of H-6Es. '50778 Blue' wears the 'nuclear' colour scheme.

The H-6D missile strike aircraft evolved into the H-6H identifiable by the ventral dielectric teardrop fairing aft of the bomb bay, probably associated with ECM. Here, H-6Hs are lined up at a PLANAF base; the serials have been covered for security reasons.

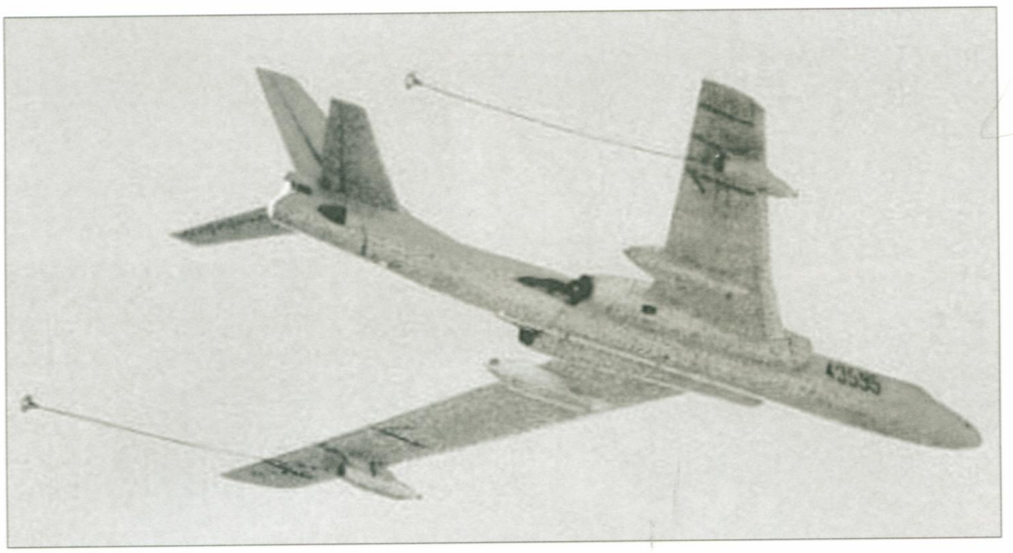
Close-up of the rear fuselages of three H-6Hs, showing the additional radomes. The aircraft in the foreground is c/n 210404, while the one next in line appears to be c/n 210401. All *China Aircraft*

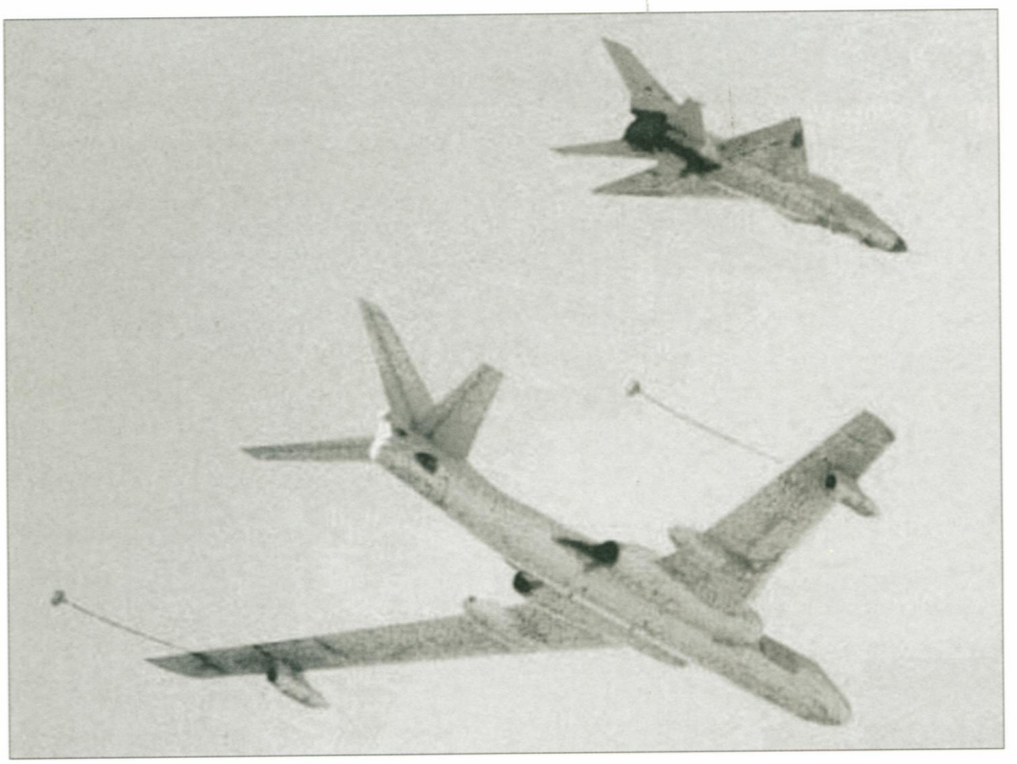
Photographs on the opposite page:

'61223 Blue outline', another H-6D in 'nuclear' colours, makes a low pass; the missiles are painted red, suggesting they are dummies or inert practice rounds. Curiously, the aircraft appears to lack defensive armament, the usual positions of the cannon turrets being faired over.

A line of 13 H-6Es at a PLAAF base. Eight of the aircraft wear an overall bluish grey colour scheme (including '50679 Blue' which used to be natural metal/white); the rest retain 'nuclear' colours. '50777 Blue' in the foreground is a bit 'unbuttoned' for maintenance.

'50679 Blue' is a modernised H-6E. Note the ECM antenna fairings at the wingtips. All *China Aircraft*





'43595 Blue', an HY-6 refuelling tanker, shows off the two podded hose drum units with the hoses deployed. The stripes on the wing underside near the HDUs are reference markings for the pilot of the receiver aircraft, serving for correct alignment prior to contact. *China Aircraft*

A PLAAF Shenyang J-8D interceptor breaks formation with HY-6 '43595 Blue' after a simulated in-flight refuelling during an airshow. *China Aircraft*

Photographs on the opposite page:

Crews run towards their aircraft as a squadron of HY-6s prepares to scramble. This view shows well the tanker's redesigned nose with a weather radar mounted in front of the navigator's station whose glazing is reduced to a narrow ring of transparencies. *China Aircraft*

A retouched photo showing an HY-6 refuelling two Shenyang J-8Ds at once. *China Aircraft*

This modified H-6 serialled '086 Blue' was the Chinese counterpart of the Tu-16LL testbeds, featuring a very similar development engine installation in a hydraulically retractable pod in the bomb bay. Note the sprinkler grid installed ahead of the engine for icing tests. *China Aircraft*

This two-point tanker is believed to be designated H-6DU. The glazed nose and the deep chin radome reveal its origins from the H-6D missile strike aircraft. *China Aircraft*

lay mines and drop smoke markers. Most Chinese bombers were produced in this version.

Reconnaissance and ECM Versions

As in the USSR, recce and ECM versions were developed from the basic H-6. Their precise designations are still unknown, but they differ externally from the bomber version in having underwing pylon-mounted pods (similar to those on the Soviet Tu-16R)

H-6D Anti-Shipping Missile Carrier

In 1975 work began on an anti-shipping version of the H-6A armed with two underwing anti-shipping missiles. The carrier, given the designation H-6D (or H-6 IV), was equipped with a missile guidance system, an automated onboard navigational system and a new surveillance radar (type 245) in a much-enlarged flat-bottomed radome linked to the missile guidance system. The wings were strengthened to carry the missiles which were suspended on pylons like those on the Tu-16R.

The YJ-6L ASM (export designation C-601, given the NATO codename *Silkworm*) was developed in the PRC from the Soviet P-15 anti-shipping missile supplied to China at the end of the 1950s. The missile had a range of 120km and a speed of Mach 0.8.

The first flight of the experimental H-6D took place on 29th August 1981, with the first launch of a YJ-6L following on 6th December. The test program for the aircraft and the ASM complex as a whole concluded at the end of 1983. In December 1985 the new anti-shipping complex entered service with the People's Liberation Army Naval Air Force (PLANAF).

In May 1985 the H-6D with its C-601 missiles was exhibited at the Paris Air Show.

Recently, the YJ-6L (C-601) has been replaced by the more modern YJ-61 (C-611) which has a range of 200km.

B-6D (Export Version of the H-6D)

A version of the H-6D for export was designated B-6D (B for bomber). Four were supplied to Iraq.

H-6E Bomber

The H-6E is a modernised version of the H-6A with upgraded onboard equipment, up-graded engines and a new ECM system. Externally it differs from the H-6A in lacking the latter's nose gun position and in its grey/sky-blue finish which makes it less visible from below.

H-6H Anti-Shipping Missile Carrier

Developed from the H-6D, the H-6H differs from its predecessor in possessing a dielectric teardrop fairing aft of the bomb bay. All defensive armament has been removed. It seems likely that the aircraft is provided with new equipment, in particular a modernised radar target detection and guidance system, and a new ECM set, the antenna for which is positioned in the ventral blister fairing. It seems also likely that its main armament is the new YJ-62 ASM with a 150-km range developed from the YJ-6, using a global positioning system or TV guidance. The H-6H and the H-6D are the PLANAF's standard strike aircraft.

H-6H (Modernised Version)

A video showing tests of a new ASM carrier based on the H-6H was made public at Airshow China-2002 held at Zhuhai-Sanzao airport. This development was characterised by four underwing pylons (two under each wing) with air-to-surface or anti-shipping missiles. It seems likely that the new aircraft will be armed with the new ASM in the YJ-8 series similar to the US AGM-84E SLAM (Stand-off Land Attack Missile) or AGM-142 Popeye missiles. It is also likely to have all-weather day/night capability.

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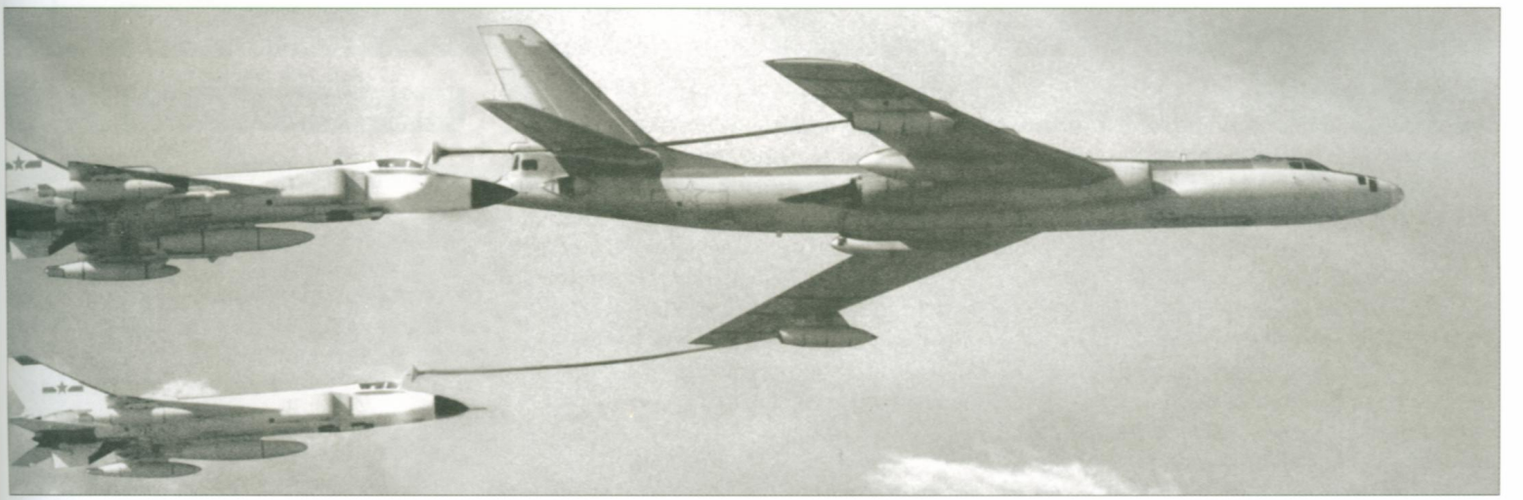

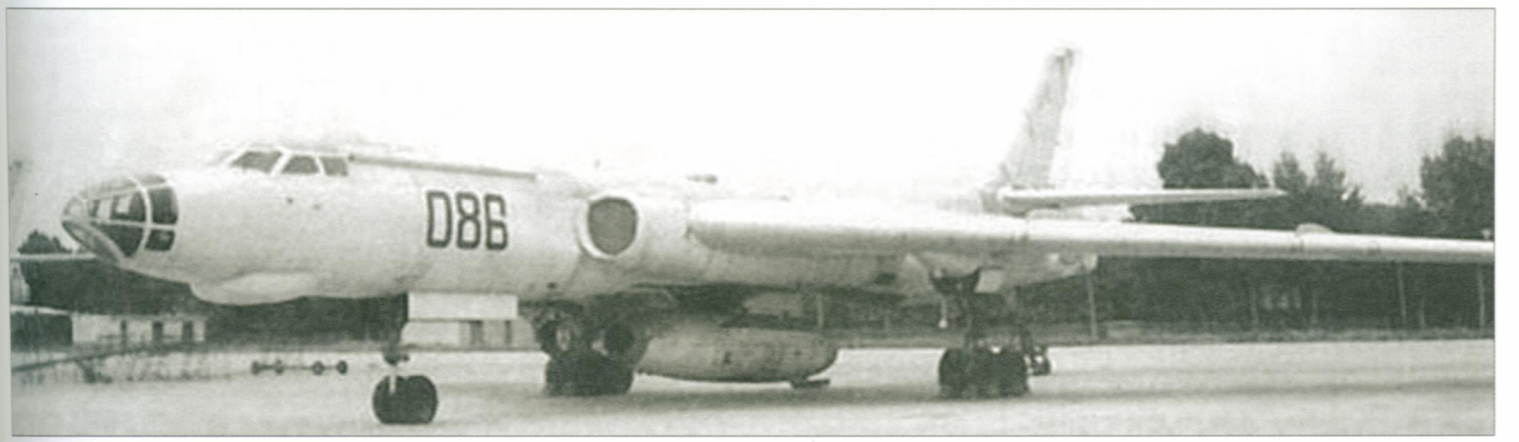
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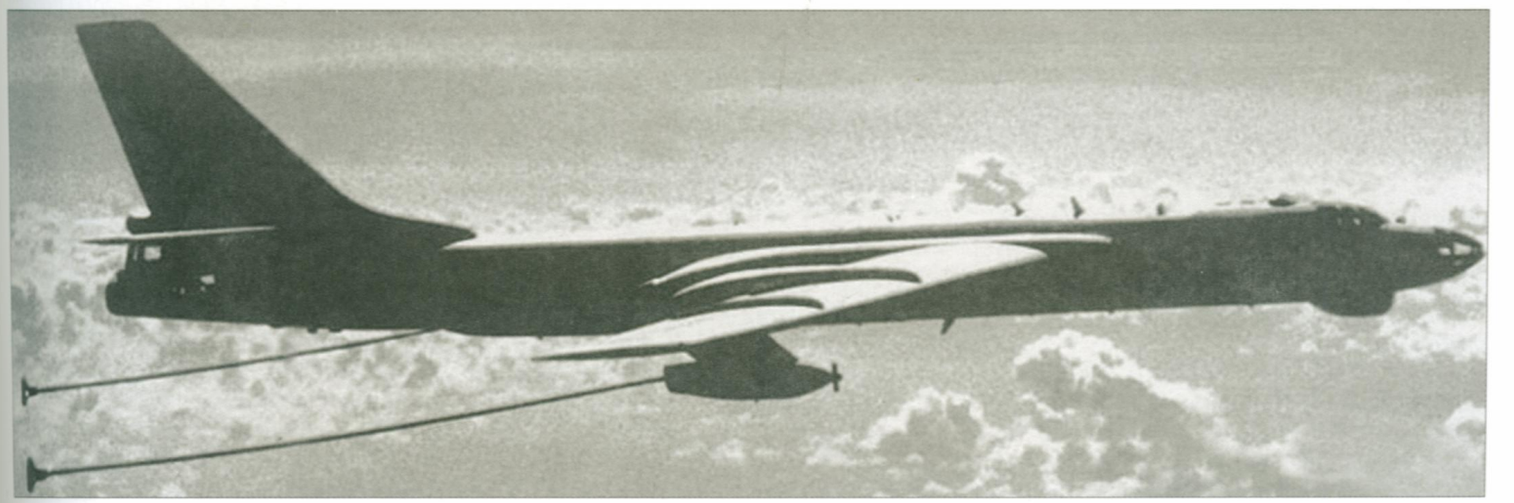
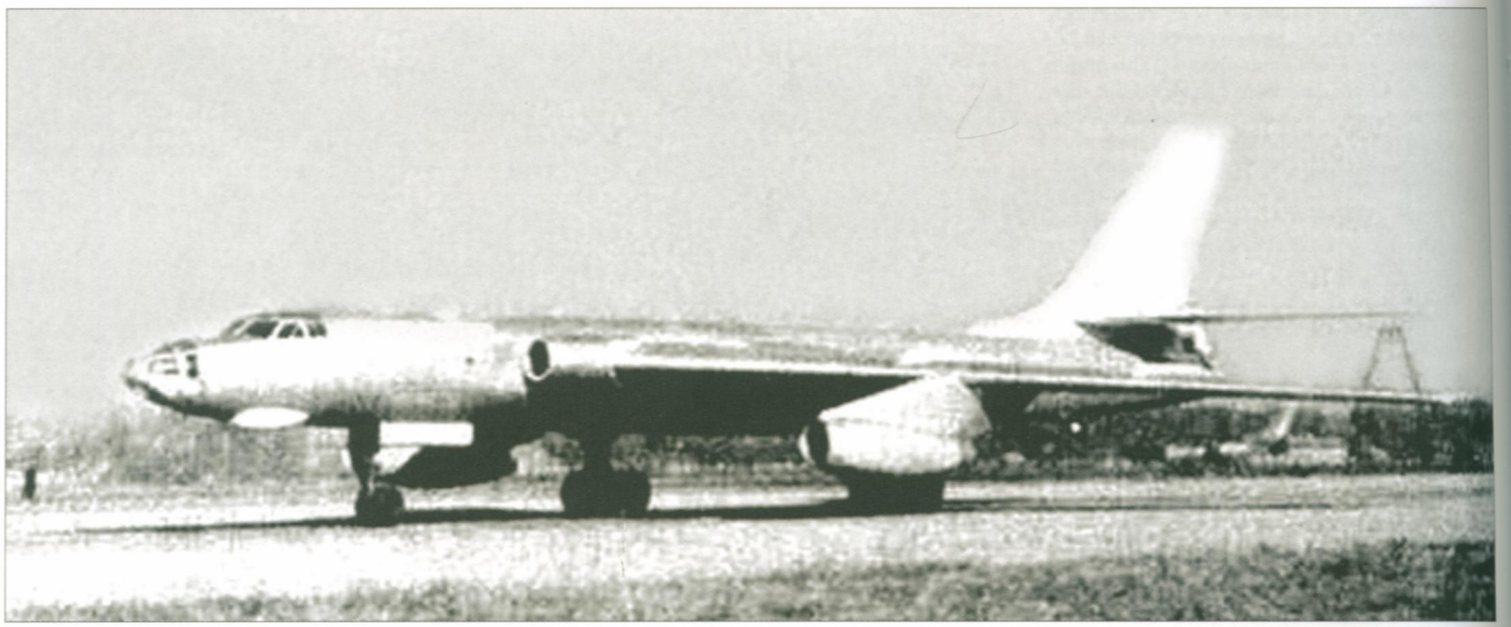




HY-6 (H-6U, HU-6) Tanker

This two-point hose-and-drogue IFR tanker was produced to extend the operation radius of the Shenyang J-8D interceptor. It has sometimes been referred to in the press as the H-6U or HU-6. Apart from the podded hose drum units (similar to the Flight Refuelling Mk 32 HDUs fitted to the Vickers VC10 C.1K), the HY-6 can be identified by the redesigned nose section with a conventionally mounted weather/navigation radar ahead of the navigator's station which has a greatly reduced glazing area (the absence of the chin radome lends the tanker a certain similarity to the Soviet Tu-16LL engine testbeds).

The first example was shown during the military parade in Beijing on 1st October 1999. Some sources date the first flight to 1990, and the aircraft was first detected by an American surveillance satellite in 1996. It is currently estimated that ten examples of the HY-6 are based on Laiyan AB in Guangzhou province. Their primary purpose seems to be the refuelling of J-8D interceptors over the South China Sea.

H-6DU Tanker

Some H-6D naval ASM carriers were converted into two-point hose-and-drogue tankers (provisionally though to be designated H-6DU). They can be distinguished from the PLAAF's standard HY-6 tanker by the forward fuselage retaining a fully glazed navigator's station and deep chin radome.

H-6 Reconnaissance Version

At least one H-6 was converted into an ELINT version with pylon-mounted underwing pods similar to the SRS-3 pods of the Soviet Tu-16R and a hemispherical dielectric blister ahead of the bomb bay. The exact designation is still unknown at present.

H-6 Target Drone Carrier Version

This is an H-6 bomber specially modified to launch high-speed, high-altitude target drones. The exact designation is likewise unknown.

Testbeds Based on the H-6

Some H-6 bombers have been refitted as testbeds for aero engines and various other systems. One of these (serialled '086 Blue', later '86 Blue') was used to test a jet engine suspended beneath the fuselage, as on the Soviet Tu-16LL. Unlike the latter type, the Chinese testbed appeared to have an icing test function, with what looked like a water sprinkler grid mounted a short way ahead of the development engine's air intake.

H-6I Testbed

Another propulsion testbed known as the H-6I has been fitted with four Rolls-Royce Spey non-afterburning turbofans. Two of these replace the normal engines and a further two are installed in pylon-mounted nacelles at about half-span.

In the 1970s and 1980s a few Chinese H-6s either replaced or augmented the Tu-16 aircraft supplied by the USSR to Egypt and Iraq.

Like the Tu-16, the H-6 bomber has been used in the PRC in various research and development work aimed at improving and developing various forms of aviation technology. The Chinese equivalent of the Soviet LII has made use of several of these testbeds.

The H-6A and H-6D differ slightly from the Soviet Tu-16, as the comparative data below shows:

	H-6A	H-6D
Length of aircraft fuselage	34.8m	34.8m
Height of aircraft from runway	10.36m	10.36m
Wing span	34.19m	34.19m
Wing Area	164.65m²	167.55m²
Weight of aircraft empty	37,729kg	38,530kg
Max take-off weight	72,000kg	72,000kg
Max speed with two C-601 SAMs	-	786km/h
Service ceiling	-	12,000m
Maximum range	-	4,300km

INDONESIA

The second country to receive Tu-16 aircraft from the USSR was Indonesia. In the summer of 1961 25 Tu-16KS missile strike aircraft (other sources give 20 examples) were transferred to the Indonesian Air Force (AURI – *Angkatan Udara Republik Indonesia*) where they formed the 41st and 42nd Squadrons based outside Djakarta. During the conflict between Indonesia and Malaysia these aircraft were used as a display of Indonesian military might, making incursions into Malaysian airspace near Singapore, although they were not used operationally. After the break between Indonesia and the USSR the Tu-16KSs sat parked for some time, grounded for lack of spares. When Indonesia acquired new Western air technology, they were scrapped. One example survives as a museum exhibit.

EGYPT

In 1963 some 20 Tu-16KSs were supplied to the Egyptian Air Force (*al Quwwat al-Jawwiya il-Misriya*) where they formed two squadrons. The aircrews were trained in the USSR and Soviet specialists took part in their service induction in Egypt. In June 1967, in the first hours of the Six-Day War, they were destroyed by Israeli aircraft on their airfields before they could take part in military operations.

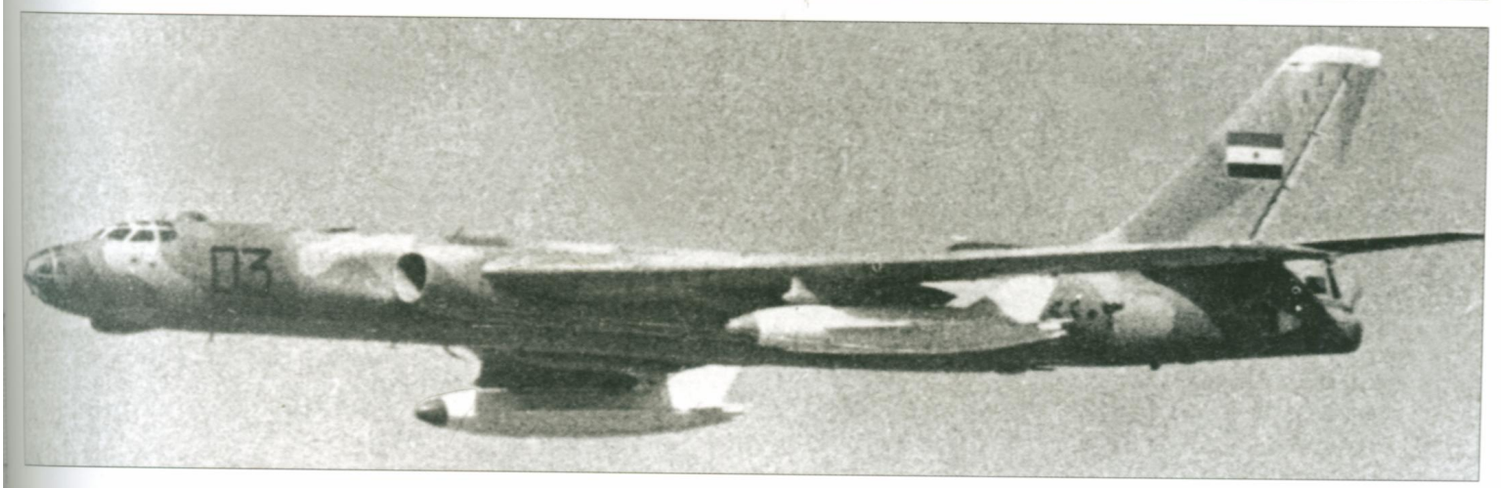
After the war, the USSR supplied the Egyptians with about 20 further Tu-16KSR-2As and Tu-16KSR-2-11s, a stock of KSR-2 ASMs, several Tu-16R reconnaissance aircraft with SRS-1 and SRS-3 SIGINT kits and Tu-16SPS ECM aircraft. A total of 25 Tu-16s was delivered. A while later, on 26th January 1966, the Soviet Council of Ministers authorised the delivery of six Tu-16T torpedo-bombers to Egypt. In September 1967 aircrews of the Black Sea Fleet Naval Air Arm ferried these machines to Cairo-West

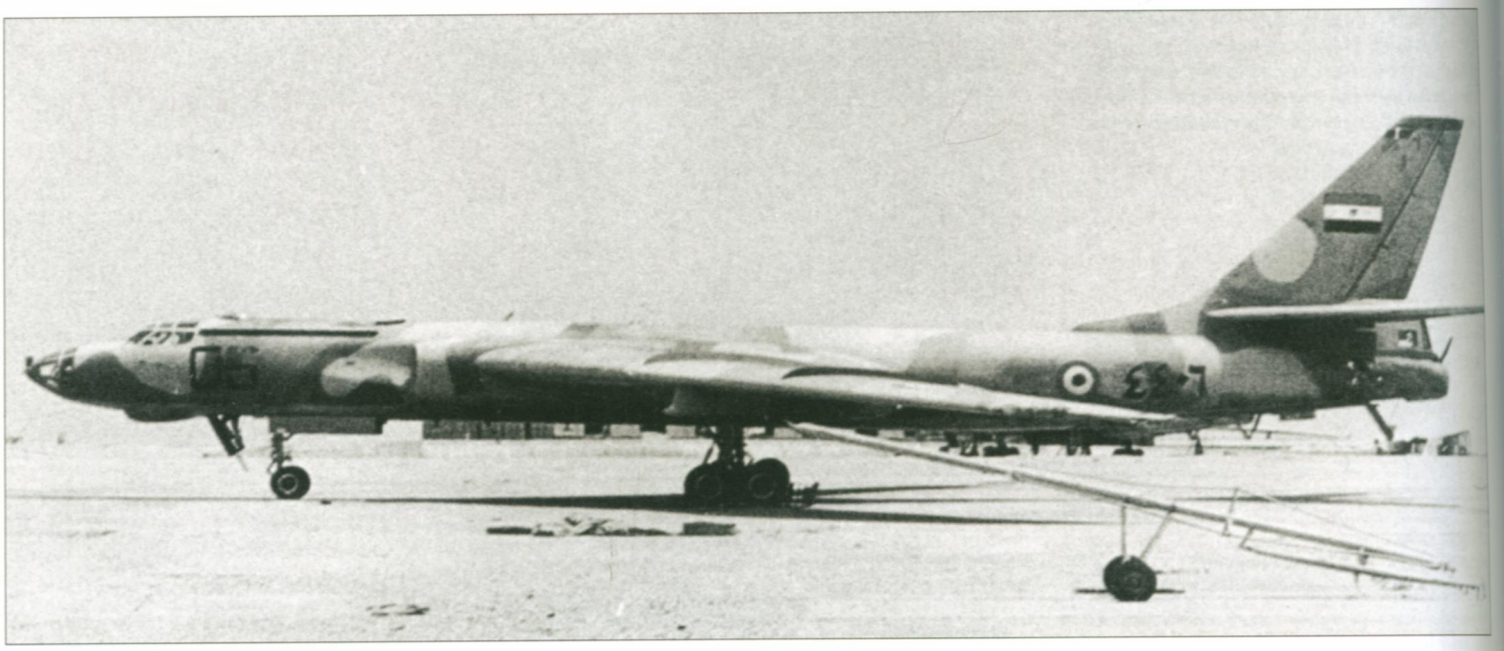
Opposit page: **A poor-quality but interesting picture of the highly modified H-6I, showing the redesigned circular intakes in the wing roots associated with the installation of RR Spey turbofans and the podded installation of the outer Speys.** *China Aircraft*

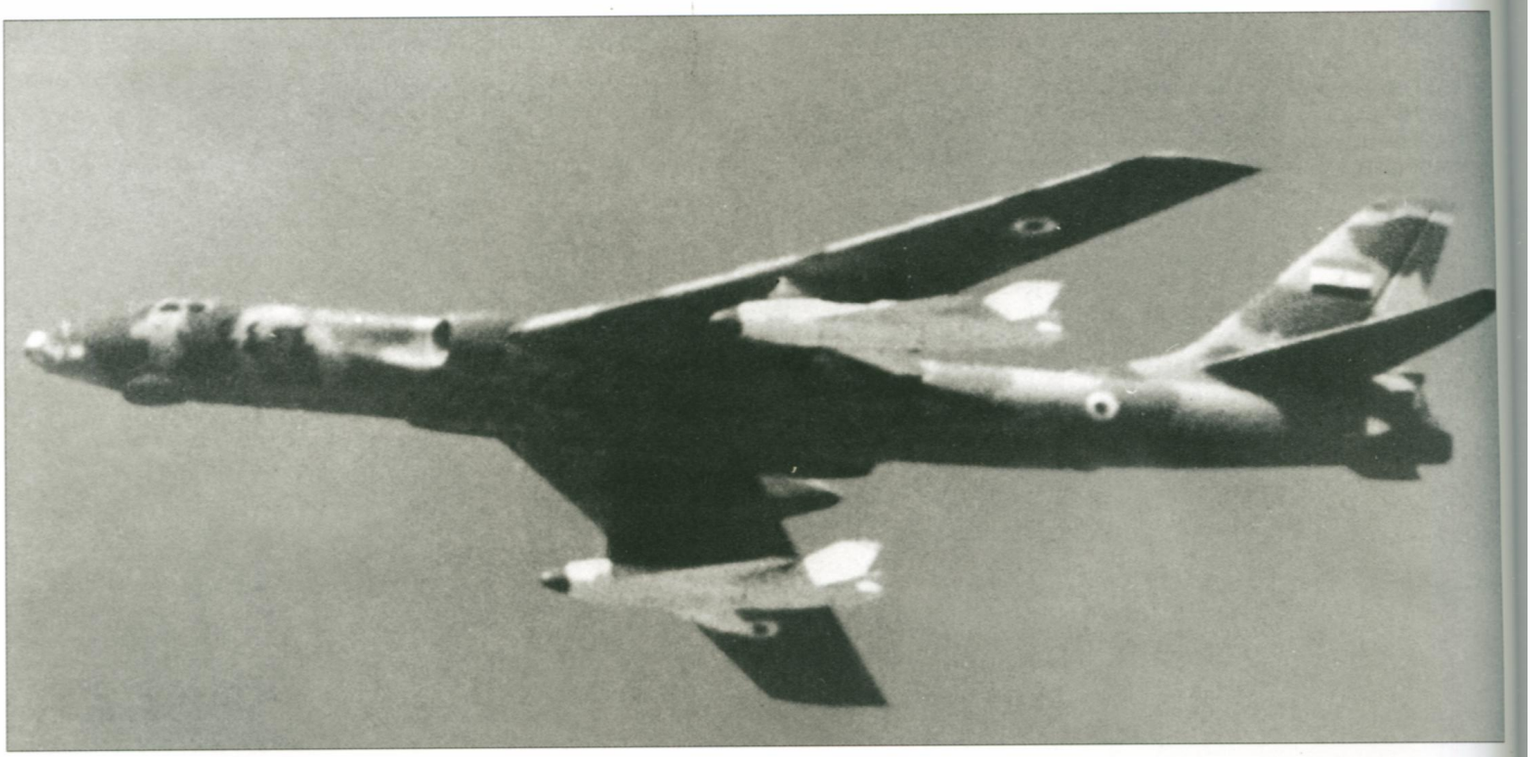
M 1618, one of 25 Tu-16KS missile carriers delivered to the Indonesian Air Force, with a full complement of missiles and a sister ship visible beyond. The ZiS-150 lorry in the background was likewise Soviet-supplied. Yefim Gordon archive

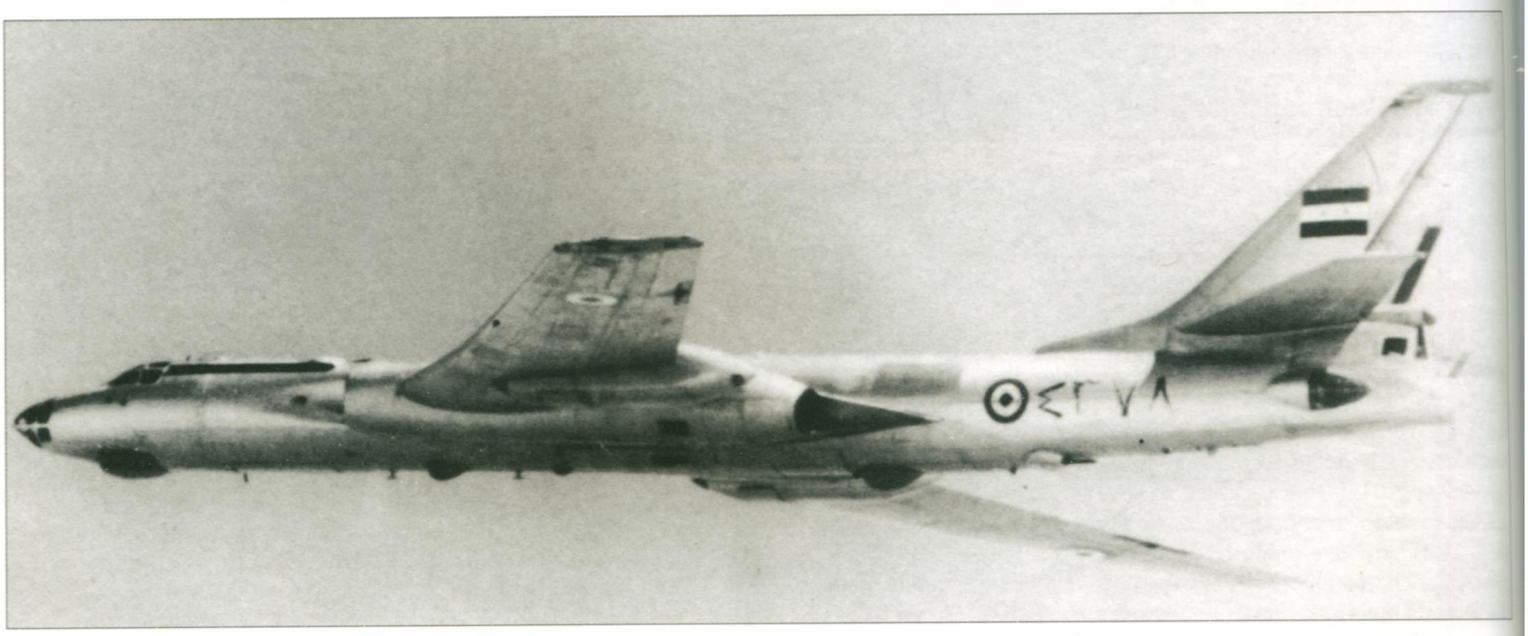
Another Indonesian Air Force Tu-16KS; the last four digits of the c/n (6203404) are visible on the tail. Yefim Gordon archive

An Egyptian Air Force Tu-16KSR-2 serialled 4403; the serial is written in Arabic numerals on the rear fuselage and the last two digits are repeated in Roman numerals on the nose. Yefim Gordon archive

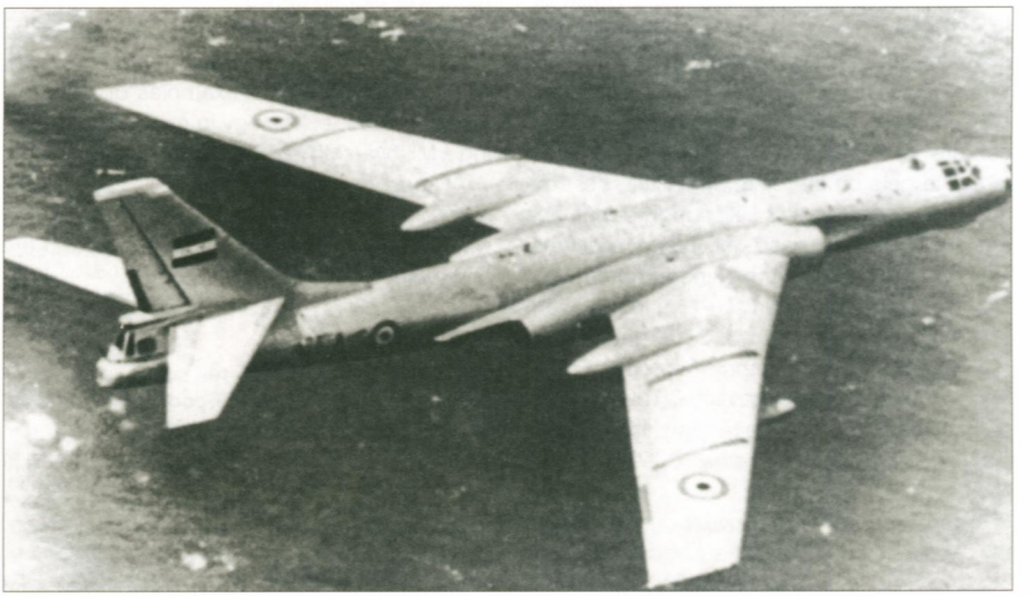






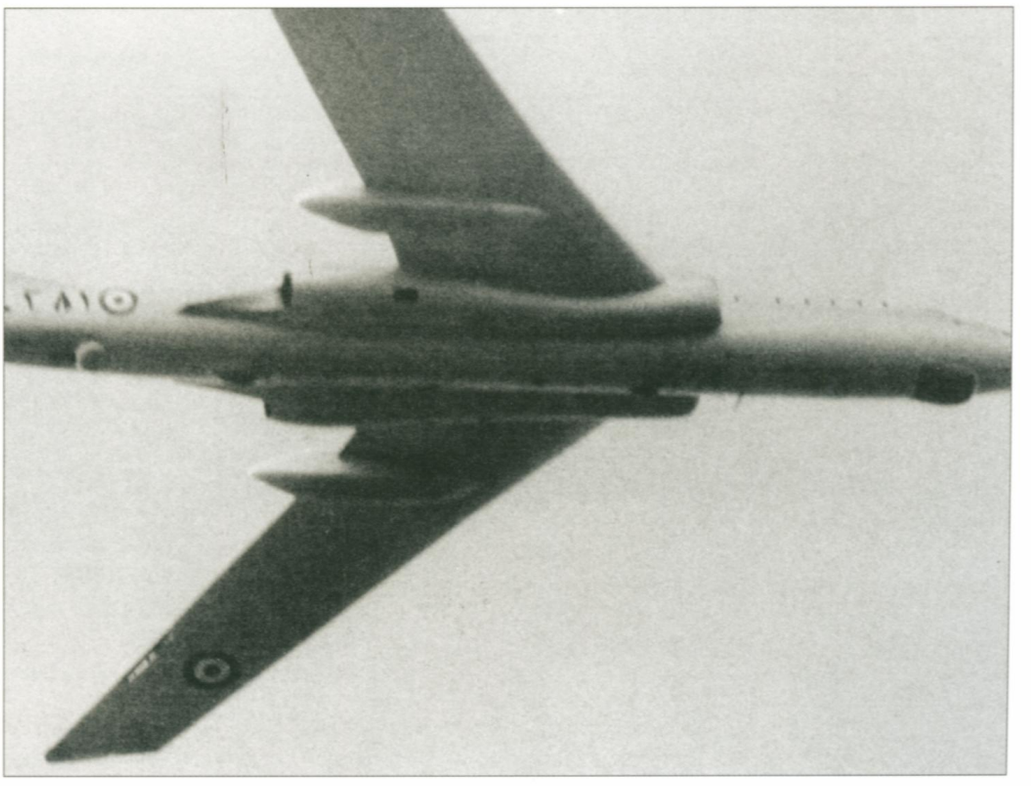


Another quasi-Egyptian Tu-16R (4376) – this time a more comprehensively equipped aircraft featuring the SRS-1 and SRS-4 SIGINT packs – is inspected by a US Navy F-4 from a carrier deployed to the Mediterranean. *Jane's All the World's Aircraft*



4384, another Soviet Navy *Badger-F* masquerading in Egyptian markings, flies above the Mediterranean. *Jane's All the World's Aircraft*

4381, one more quasi-Egyptian Tu-16R *Badger-E*, banks away from its US Navy shadower. *Jane's All the World's Aircraft*

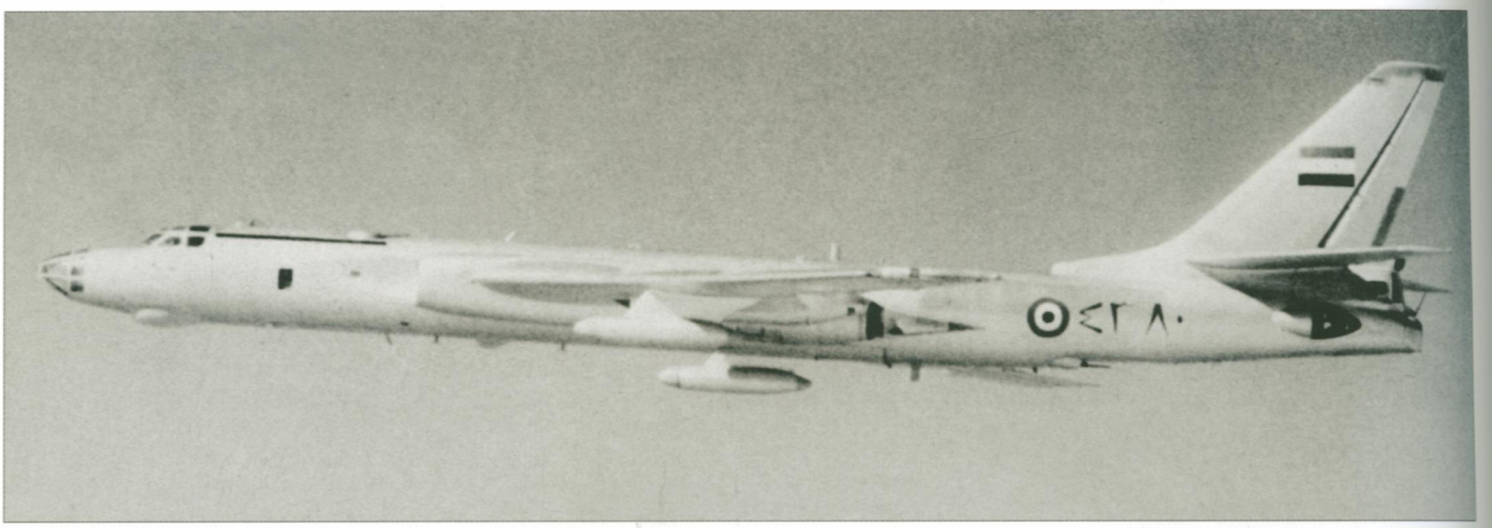


Photographs on the opposite page:

4403, an Egyptian Air Force Tu-16KSR-2-11; note the antenna array of the Ritsa radar homing system on the nose. Egyptian *Badgers* wore a three-tone camouflage. Yefim Gordon archiveTop: **Another quasi-Egyptian Tu-16R (4376) – this time a more comprehensively equipped aircraft featuring the SRS-1 and SRS-4 SIGINT packs – is inspected by a US Navy F-4 from a carrier deployed to the Mediterranean.** *Jane's All the World's Aircraft*

Another Egyptian Tu-16KSR-2 serialled 4404; this one sports only the Arabic serial which is carried on the nose rather than on the rear fuselage as is customary. Yefim Gordon archive

This allegedly Egyptian Tu-16R serialled 4378 and equipped only with the SRS-1 SIGINT pack is in fact an impostor – a Soviet Navy aircraft on temporary deployment in Egypt. The EAF roundels and fin flash were applied in order to avoid political complications but, unlike the EAF, the Soviet Navy did not bother repainting the aircraft. *Jane's All the World's Aircraft*



airfield where Egyptian crews were trained under the supervision of Soviet instructors. Hosni Mubarak, the future president of Egypt, was taken for a flight in one of them. These aircraft equipped two squadrons which took an active part in operations during the Yom Kippur War of October 1973. In the course of this 'second round' of hostilities Egyptian Tu-16 ASM carriers launched some 25 missiles against Israeli targets on the Sinai Peninsula, destroying two radar sites and a field supply depot. The Tu-16R was also used for recce missions. Mindful of the experience gained from the Six-Day War, the Egyptian Tu-16 aircraft were based on airfields south of Sinai beyond the reach of the Israeli Defence Force/Air Force. According to the Egyptians, their Tu-16 aircraft suffered no losses – although the Israelis claimed one destroyed.

After the break between Egypt and the USSR in the spring of 1976, the Soviets cut off the supply of spares for all the military equipment they had provided. In an endeavour to maintain their machines in operational condition, the Egyptians turned to China. In April 1976 an agreement was signed between the two countries by which the PRC furnished Egypt with spares for their H-6s. The Western press claimed that China acquired several examples of the latest Soviet military technology in exchange, including a Mikoyan MiG-23BN ground attack aircraft.

At the beginning of 1990 the Egyptian Air Force operated 16 examples of the Tu-16 which formed a bomber brigade based in the south of the country.

Above: **Quasi-Egyptian Tu-16R *Badger-F* '4380' shows off the SRS-3 SIGINT pods and the camera port in the forward fuselage.** *Jane's All the World's Aircraft*

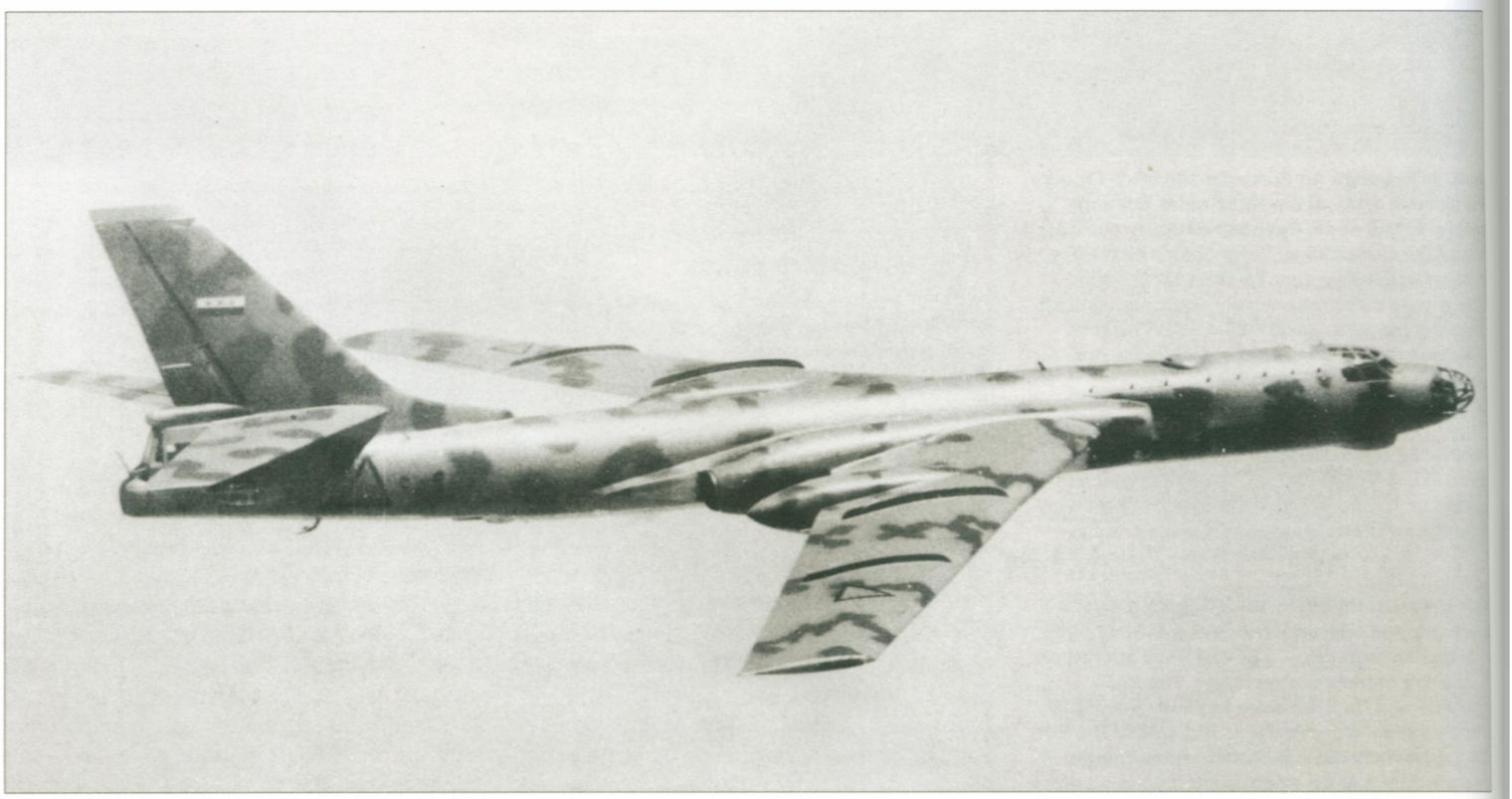
Below: **An Iraqi Air Force Tu-16 in flight. Examples delivered to the Iraq wore this sand/green camouflage.** Yefim Gordon archive

IRAQ

In the 1970s, the Iraqi Air Force (*al Quwwat al-Jawwiya al-Iraqiya*) acquired eight Tu-16KSR-2-11s and some examples of the Tu-22 which were used to form two bomber squadrons. These aircraft were used during the Iran-Iraq war of 1980-88 to bomb Iranian positions, as well as military and civilian targets in Iran. In particular, Tu-16KSR-2-11 aircraft bombed Teheran airport. The Iraqi Tu-16 ASM carriers also carried out several missile launches against Iranian objectives.

Subsequently, Iraq purchased four H-6D from the PRC with a large number of C-601 ASMs. After the disintegration of the USSR, China supplied Iraq with spares for its Tu-16 and H-6 fleet.

At the outbreak of the Gulf War in 1991 virtually all Iraqi Tu-16s had come to the end of their service lives and were grounded. Some were damaged in Allied air strikes and some destroyed on the ground.



Production List

Tu-16 production is presented in construction number order for each factory, with all identities worn consecutively by each aircraft. The four-digit numbers given after a slash with the c/ns of some Kazan'-built aircraft were carried on the tail below the c/n; the first digit is again the year of manufacture, followed by what is probably the sequence number of the aircraft built as a missile carrier.

For each aircraft, the versions are marked 'in order of appearance' to show how this or that aircraft was converted in the course of its service life. 'Deceased' (that is, crashed) examples are marked with † (RIP crosses) followed by the date and location of the accident; the letters in parentheses following this mean 'fatal accident' (f) or 'non-fatal accident' (nf).

Kazan' Aircraft Factory No 22

System 1: '25 Red', c/n 7.2.039.20 = manufactured in 1957, plant No 22, Batch 39, 20th aircraft in the batch

Construction number	*Version*	*Tactical code/ Registration*	*Manufacture date*[1]	*Notes*
3200101	Tu-16		?-12-1953	203rd TBAP, Baranovichi; ?? TBAP, Kiev-Borispol'
3200102	Tu-16		?-12-1953	?? TBAP;
	Tu-16A			?? TBAP, Bagerovo AB
3200103	Tu-16		?-1-1954	?? TBAP;
	Tu-16A			?? TBAP, Bagerovo AB
3200104	Tu-16		?-1-1954	203rd TBAP, Baranovichi
3200105	Tu-16		?-1-1954	LII; 402nd TBAP, Balbasovo AB
4200201	Tu-16	no code	?-2-1954	203rd TBAP, Baranovichi
4200202	Tu-16		?-2-1954	402nd TBAP, Balbasovo AB † 6-4-1954 Balbasovo (f)
4200203	Tu-16		?-2-1954	402nd TBAP, Balbasovo AB; GK NII VVS
4200204	Tu-16		24-3-1954	203rd TBAP, Baranovichi; 402nd TBAP, Balbasovo AB
4200205	Tu-16		24-3-1954	203rd TBAP, Baranovichi
4200301	Tu-16		?-3-1954	203rd TBAP, Baranovichi
4200302	Tu-16		?-3-1954	203rd TBAP, Baranovichi; GK NII VVS
4200303	Tu-16	36 Black	?-4-1954	203rd TBAP, Baranovichi; 402nd TBAP, Balbasovo AB; ?? TBAP, Bagerovo AB; Tupolev OKB/Kazan' branch
4200304	Tu-16		?-4-1954	203rd TBAP, Baranovichi
4200305	Tu-16	no code	?-4-1954	
	Tu-16KS			prototype
4200401	Tu-16	72 Red	?-5-1954	?? TBAP, Engels-2 AB
4200402	Tu-16			To plant No 1 as CKD kit
4200403	Tu-16		?-5-1954	
4200404	Tu-16	44 Red	?-5-1954	LII, de-icing system testbed
4200405	Tu-16		?-5-1954	
	Tu-16KS			
4200501	Tu-16	77 Red	?-6-1954	
	Tu-16T		3-8-1954	prototype, NII AVMF, Feodosiya
4200502	Tu-16A		?-6-1954	402nd TBAP, Balbasovo AB
4200503	Tu-16	71 Red (Ukraine AF)	?-6-1954	
	Tu-16A			251st TBAP
	Tu-16V			
4200504	Tu-16A		?-7-1954	Tupolev OKB; ?? TBAP, Bagerovo AB;
4200505				To plant No 1 as CKD kit, see c/n 1880001
4200601	Tu-16A	72	?-6-1954	
4200602	Tu-16A	?	?-7-1954	402nd TBAP, Balbasovo AB
		29 Blue (Ukraine AF)	251st TBAP	
4200603	Tu-16A		?-6-1954	402nd TBAP, Balbasovo AB
4200604	Tu-16A		?-7-1954	?? TBAP, Kiev-Borispol'
4200605	Tu-16A		?-7-1954	Converted to Tu-16KS?
4200701	Tu-16A		?-7-1954	
4200702	Tu-16A		?-7-1954	?? TBAP, Kiev-Borispol'
4200703	Tu-16A	?	?-8-1954	
	Tu-16K-26	40 Red (Ukraine AF)		
4200704	Tu-16A		?-8-1954	402nd TBAP, Balbasovo AB
4200705	Tu-16A		?-8-1954	
4200801	Tu-16A		?-8-1954	
4200802	Tu-16A		?-8-1954	
4200803	Tu-16A		?-8-1954	
4200804	Tu-16A		?-8-1954	† 15-2-1955 (nf) destroyed by fire
4200805	Tu-16A	83 Yellow (Ukraine AF)	?-8-1954	260th TBAP, Stryy
4200901	Tu-16A		?-9-1954	
4200902	Tu-16A		?-9-1954	
4200903	Tu-16A		?-9-1954	
4200904	Tu-16A		?-9-1954	
4200905	Tu-16A		?-9-1954	
4201001	Tu-16KS		?-9-1954	
4201002	Tu-16A	?	?-11-1954	Production standard for 1955; LII
	Tu-16LL	02 Blue		
4201003	Tu-16A		?-9-1954	
4201004	Tu-16A		?-9-1954	
	Tu-16K-11-16			Preserved Russian AF Museum, Monino, now as '53 Red'
	Tu-16K-26	53 Blue		
4201005	Tu-16A		?-10-1954	
4201101	Tu-16KS		?-10-1954	
4201102	Tu-16KS		?-10-1954	
4201103	Tu-16A		?-11-1954	
4201104	Tu-16A		?-11-1954	
4201105	Tu-16A	23 Red	?-10-1954	
4201106	Tu-16KS		?-10-1954	
4201107	Tu-16A		?-10-1954	
4201108	Tu-16A		?-11-1954	
4201109	Tu-16A		?-11-1954	† 15-2-1955 Tartu (f)
4201110	Tu-16A	74 Yellow (Ukraine AF)	?-11-1954	251st TBAP
4201201	Tu-16A		?-11-1954	
4201202	Tu-16A		?-11-1954	
4201203	Tu-16A		?-12-1954	
4201204	Tu-16A	20	?-12-1954	
4201205	Tu-16A		?-12-1954	
4201206	Tu-16A		?-12-1954	
4201207	Tu-16A		?-12-1954	
4201208	Tu-16A; M-16?	14 Red?	?-12-1954	M-16 may be c/n 8204208?
4201209	Tu-16A		?-12-1954	
4201210	Tu-16A		?-12-1954	
4201301	Tu-16A		?-12-1954	
4201302	Tu-16A		?-12-1954	
4201303	Tu-16A		?-12-1954	
5201304	Tu-16A		?-12-1954	
5201305			?-2-1955	
5201306			?-2-1955	
5201307			?-2-1955	
5201308	Tu-16	65 Red	?-2-1955	
		17 Red		
5201309	Tu-16, Tu-16M		?-2-1955	
5201310	Tu-16, Tu-16M		?-2-1955	
5201401			?-2-1955	
5201402			?-2-1955	
5201403			?-2-1955	
5201404		63 Red	?-2-1955	
5201405			?-2-1955	
5201406		70 Red	?-2-1955	
5201407			?-2-1955	
5201408	Tu-16, Tu-16KSR-2-5	17	?-2-1955	
5201409			?-2-1955	
5201410		07 Black	?-3-1955	

Construction number	Version	Tactical code/ Registration	Manufacture date[1]	Notes
5201501			?-3-1955	
5201502			?-3-1955	
5201503	Tu-16A		?-3-1955	
5201504			?-3-1955	
5201505			?-3-1955	
5201506			?-3-1955	
5201507			?-3-1955	
5201508			?-3-1955	
5201509			?-3-1955	
5201510		32 Blue	?-3-1955	
5201601			?-3-1955	
5201602			?-3-1955	† 30-5-1957 (f)
5201603		21, 43 Red	?-3-1955	Code '43 Red' is unconfirmed
5201604	Tu-16KSR-2?	25 Blue	?-3-1955	
5201605			?-3-1955	184th TBAP, Priluki. 17-8-1957 (f)
5201606			?-4-1955	
5201607	Tu-16A		?-3-1955	'order 684/1'
5201608			?-3-1955	
5201609			?-3-1955	
5201610			?-3-1955	
5201701			?-4-1955	
5201702			?-4-1955	
5201703			?-4-1955	
5201704			?-4-1955	
5201705			?-4-1955	
5201706			?-4-1955	
5201707			?-4-1955	
5201708			?-4-1955	
5201709			?-4-1955	
5201710			?-4-1955	
5201801			?-4-1955	
5201802			?-4-1955	
5201803			?-4-1955	
5201804	Tu-16A		?-4-1955	
5201805			?-5-1955	
5201806			?-5-1955	
5201807			?-5-1955	
5201808			?-5-1955	
5201809			?-5-1955	
5201810			?-5-1955	
5201901			?-5-1955	
5201902			?-5-1955	† 23-12-1958 (f)?
5201903			?-5-1955	
5201904	Tu-16A	19 Red	?-5-1955	
5201905			?-5-1955	
5201906			?-5-1955	
5201907	Tu-16 Tu-16P Buket		?-5-1955	
5201908		13 Red?	?-5-1955	
5201909			?-5-1955	
5201910		21	?-6-1955	GIA Yegor'yevsk tech school
5202001			?-6-1955	
5202002			?-6-1955	
5202003			?-6-1955	
5202004			?-6-1955	
5202005			?-6-1955	
5202006			?-6-1955	
5202007			?-6-1955	
5202008	Tu-16A Tu-16K-11-16		?-6-1955	
5202009	Tu-16 Tu-16K-11-16	52 Red	?-6-1955	
5202010	Tu-16A Tu-16KSR-2? Tu-16KSR-2-5	66 Red	?-6-1955	
5202101	Tu-16A		?-6-1955	
5202102	Tu-16A		?-6-1955	
5202103	Tu-16A		?-6-1955	
5202104	Tu-16A	35	?-6-1955	
5202105	Tu-16A		?-6-1955	
5202106	Tu-16A		?-6-1955	
5202107	Tu-16A		?-7-1955	
5202108	Tu-16A		?-7-1955	
5202109	Tu-16A		?-7-1955	
5202110	Tu-16A		?-7-1955	
5202201	Tu-16A		?-7-1955	
5202202	Tu-16A		?-7-1955	
5202203	Tu-16A		?-7-1955	
5202204	Tu-16A		?-7-1955	
5202205	Tu-16A		?-7-1955	
5202206	Tu-16A		?-7-1955	
5202207	Tu-16A		?-7-1955	
5202208	Tu-16A		?-7-1955	
5202209	Tu-16A		?-7-1955	
5202210	Tu-16A		?-7-1955	

Construction number	Version	Tactical code/ Registration	Manufacture date[1]	Notes
5202301	Tu-16A		?-7-1955	† 10-1-1957 (f)?
5202302	Tu-16A		?-7-1955	
5202303	Tu-16A		?-7-1955	
5202304	Tu-16A		?-8-1955	
5202305	Tu-16A		?-7-1955	
5202306	Tu-16A		?-7-1955	
5202307	Tu-16A		?-9-1955	
5202308	Tu-16A		?-8-1955	
5202309	Tu-16A		?-9-1955	
5202310	Tu-16A		?-8-1955	† 2-2-1956 (f)
5202401	Tu-16A		?-9-1955	
5202402	Tu-16A		?-9-1955	
5202403	Tu-16A		?-9-1955	
5202404	Tu-16A		?-9-1955	
5202405	Tu-16A		?-9-1955	
5202406	Tu-16A		?-9-1955	
5202407	Tu-16A		?-9-1955	
5202408	Tu-16A		?-9-1955	
5202409	Tu-16A		?-9-1955	
5202410	Tu-16A		?-9-1955	
5202501	Tu-16A with 'ECM tail' Tu-16K-11-16	28 Red	?-9-1955	SPS-100 & SPS-5 refit
5202502	Tu-16A		?-9-1955	
5202503	Tu-16A		?-9-1955	
5202504	Tu-16A		?-9-1955	
5202505	Tu-16A		?-9-1955	
5202506	Tu-16A M-16	15 Red	?-9-1955	GK NII VVS/Akhtoobinsk
5202507	Tu-16A		?-9-1955	
5202508	Tu-16A		?-9-1955	
5202509	Tu-16A		?-9-1955	
5202510	Tu-16A		?-9-1955	
5202601	Tu-16A		?-9-1955	
5202602	Tu-16A Tu-16P Buket	94 Red	?-9-1955	
5202603	Tu-16A		?-9-1955	
5202604	Tu-16A		?-9-1955	
5202605	Tu-16A	11 Red	?-9-1955	
5202606	Tu-16A		?-9-1955	
5202607	Tu-16A		?-9-1955	
5202608	Tu-16A		?-9-1955	
5202609	Tu-16A		?-9-1955	
5202610	Tu-16A		?-9-1955	
5202611	Tu-16A		?-9-1955	
5202612	Tu-16A		?-9-1955	
5202613	Tu-16A		?-9-1955	
5202614	Tu-16A Tu-16KSR-2A	23	?-9-1955	
5202615	Tu-16A		?-10-1955	
5202616	Tu-16KS		?-10-1955	
5202617	Tu-16KS		?-10-1955	
5202618	Tu-16KS		?-10-1955	
5202619	Tu-16KS		?-10-1955	
5202620	Tu-16A		?-10-1955	
5202701	Tu-16A		?-10-1955	
5202702	Tu-16A		?-10-1955	
5202703	Tu-16A		?-10-1955	184th TBAP, Priluki. † 17-4-1956 (f)
5202704	Tu-16A		?-10-1955	
5202705	Tu-16A		?-10-1955	
5202706	Tu-16A		?-10-1955	
5202707	Tu-16A		?-10-1955	
5202708	Tu-16A		?-10-1955	
5202709	Tu-16A		?-10-1955	
5202710	Tu-16A		?-10-1955	
5202711	Tu-16A		?-10-1955	
5202712	Tu-16A		?-10-1955	
5202713	Tu-16A		?-11-1955	
5202714	Tu-16A		?-11-1955	
5202715	Tu-16A		?-11-1955	
5202716	Tu-16KS		?-10-1955	
5202717	Tu-16KS		?-11-1955	
5202718	Tu-16A		?-11-1955	
5202719	Tu-16A		?-11-1955	
5202720	Tu-16A		?-11-1955	
5202801	Tu-16A		?-11-1955	
5202802	Tu-16A		?-11-1955	
5202803	Tu-16A		?-11-1955	
5202804	Tu-16A		?-11-1955	
5202805	Tu-16A		?-11-1955	
5202806	Tu-16A		?-11-1955	
5202807	Tu-16A		?-11-1955	
5202808	Tu-16A		?-11-1955	185th TBAP, Poltava. † 26-7-1956 (f)
5202809	Tu-16A		?-11-1955	
5202810	Tu-16A		?-11-1955	
5202811	Tu-16KS		?-11-1955	
5202812	Tu-16KS		?-11-1955	
5202813	Tu-16KS		?-11-1955	

Construction number	Version	Tactical code/ Registration	Manufacture date[1]	Notes
5202814	Tu-16A		?-12-1955	
5202815	Tu-16A		?-12-1955	
5202816	Tu-16A		?-12-1955	
5202817	Tu-16A		?-12-1955	
5202818	Tu-16A		?-12-1955	
5202819	Tu-16A		?-12-1955	
5202820	Tu-16A		?-12-1955	
5202901	Tu-16A		?-12-1955	† 3-2-1957 (f)?
5202902	Tu-16A		?-12-1955	
5202903	Tu-16A		?-12-1955	
5202904	Tu-16A		?-12-1955	
5202905	Tu-16A		?-12-1955	† 28-9-1957 (f)
5202906	Tu-16A		?-12-1955	
5202907	Tu-16KSR-2 Tu-16P Rezeda M-16-3	17 Red/17 Black	?-12-1955	GK NII VVS/Akhtoobinsk Converted under Elektron R&D programme
5202908	Tu-16A	14 Red	?-12-1955	200th TBAP, Bobruisk. † 10-2-1956 (nf)
5202909	Tu-16A		?-12-1955	
5202910	Tu-16A		?-12-1955	
5202911	Tu-16A		?-12-1955	† 10-4-1958 (f)
5202912	Tu-16A		?-12-1955	
5202913	Tu-16A		?-12-1955	
5202914	Tu-16A		?-12-1955	
-202915	Tu-16A		?-2-1956	
-202916	Tu-16A		?-1-1956	
6202917	Tu-16A		?-2-1956	† 18-1-1956 Kazan'-Borisoglebskoye (f)
6202918	Tu-16A		?-2-1956	
6202919	Tu-16A		?-2-1956	
6202920	Tu-16A		?-2-1956	
6203001	Tu-16A Tu-16K-26	72 Blue	?-2-1956	
6203002	Tu-16A		?-2-1956	
6203003	Tu-16A		?-2-1956	
6203004	Tu-16A Tu-16K-26P	54	?-2-1956	
6203005	Tu-16A		?-2-1956	
6203006	Tu-16A		?-?-1956	
6203007	Tu-16A		?-2-1956	
6203008	Tu-16A		?-2-1956	
6203009	Tu-16A		?-2-1956	
6203010	Tu-16A		?-2-1956	260th TBAP, Stryy. † 26-7-1956 (f)
6203011	Tu-16A		?-2-1956	
6203012	Tu-16A		?-2-1956	
6203013	Tu-16A		?-2-1956	
6203014	Tu-16A		?-2-1956	
6203015	Tu-16A		?-2-1956	
6203016	Tu-16A	10 Red	?-3-1956	
6203017	Tu-16A		?-3-1956	
6203018	Tu-16A		?-3-1956	
6203019	Tu-16A		?-3-1956	
6203020	Tu-16A		?-3-1956	260th TBAP, Stryy. † 21-3-1957 (f)
6203101	Tu-16A	35 Red	?-3-1956	
6203102	Tu-16A Tu-16K-26 Tu-16K-26P	18 Blue	?-3-1956	
6203103	Tu-16A		?-3-1956	
6203104	Tu-16A		?-3-1956	
6203105	Tu-16A		?-3-1956	
6203106	Tu-16A Tu-16K-...	? (ATC callsign CCCP-07514 which is An-2TP c/n 1G 15242)	?-3-1956	30th VA/55th TBAD/303rd TBAP. † 24-8-1981 nr Zavitinsk (f), collided with An-24PB CCCP-46653 (c/n 47309204)
6203107	Tu-16A		?-4-1956	
6203108	Tu-16A		?-3-1956	
6203109	Tu-16A		?-4-1956	
6203110	Tu-16KS Tu-16K-11-16	02 Red	?-5-1956	
6203111	Tu-16KS		?-5-1956	
6203112	Tu-16KS Tu-16K-11-16	02	?-5-1956	
6203113	Tu-16A		?-4-1956	
6203114	Tu-16A		?-4-1956	402nd TBAP, Balbasovo AB † 4-7-1957 (f)
6203115			?-5-1956	
6203116	Tu-16KS		?-6-1956	
6203117	Tu-16KS		?-6-1956	
6203118	Tu-16A		?-5-1956	
6203119	Tu-16A		?-5-1956	
6203120	Tu-16A		?-4-1956	† 6-7-1956 (f)
6203121	Tu-16A	04 Red	?-5-1956	
6203122	Tu-16A		?-5-1956	
6203123	Tu-16A		?-5-1956	
6203124	Tu-16A		?-5-1956	
6203125	Tu-16KS	25 Blue	?-5-1956	
6203126	Tu-16KS		?-5-1956	
6203127	Tu-16KS	16 Blue	?-8-1956	
6203128			?-5-1956	
6203129			?-5-1956	
6203130	Tu-16KS Tu-16KSR-2 Tu-16KSR-2-5		?-6-1956	
6203201	Tu-16KS		?-6-1956	
6203202	Tu-16KS		?-6-1956	
6203203	Tu-16A Tu-16KSR-2-5/Rubin-1N Tu-16 Tsiklon-N Tu-16 Tsiklon-NM	CCCP-42355 No 1	?-6-1956	Tu-16K-11-16?
6203204	Tu-16A		?-6-1956	840th TBAP, Sol'tsy AB † 24-8-1957 (f)
6203205	Tu-16A		?-6-1956	
6203206	Tu-16A		?-6-1956	
6203207	Tu-16A		?-6-1956	
6203208	Tu-16A Tu-16KSR-2-5/Rubin-1N Tu-16 Tsiklon-N	CCCP-42484	?-6-1956	Tu-16K-11-16?
6203209	Tu-16KS		?-7-1956	
6203210	Tu-16KS		?-7-1956	
6203211	Tu-16A		?-6-1956	
6203212	Tu-16A		?-6-1956	?? TBAP, Vozdvizhenka AB † 25-2-1957 (f)
6203213	Tu-16A		?-6-1956	
6203214	Tu-16A		?-8-1956	
6203215			?-7-1956	
6203216	Tu-16KS		?-8-1956	
6203217			?-7-1956	
6203218		24 Red	?-7-1956	
6203219			?-8-1956	
6203220	Tu-16KS		?-10-1956	
6203221			?-8-1956	
6203222			?-8-1956	
6203223	Tu-16KS		?-11-1956	
6203224			?-8-1956	
6203225	Tu-16KS		?-10-1956	
6203226	Tu-16KS		?-10-1956	
6203227	Tu-16KS		?-11-1956	
6203228		86	?-8-1956	GIA Yegor'yevsk tech school
6203229			?-8-1956	
6203230	Tu-16KS		?-11-1956	
6203301			?-8-1956	
6203302			?-8-1956	
6203303	Tu-16KS		?-9-1956	
6203304			?-9-1956	
6203305	Tu-16KS		?-9-1956	
6203306	Tu-16A		?-8-1956	?? TBAP, Vozdvizhenka AB † 31-8-1957 (f)
6203307			?-9-1956	
6203308	? Tu-16KSR-2-5	08	?-9-1956	
6203309			?-9-1956	
6203310/6030?	? Tu-16K-11-16?	85 Blue?	?-9-1956	
6203311			?-9-1956	
6203312			?-9-1956	
6203313			?-9-1956	
6203314			?-9-1956	
6203315	Tu-16KS		?-10-1956	
6203316	Tu-16A		?-9-1956	?? TBAP, Skomorokhi AB † 29-5-1958 (f)?
6203317	Tu-16KS		?-10-1956	
6203318			?-9-1956	
6203319	Tu-16KS		?-10-1956	
6203320			?-9-1956	
6203321			?-10-1956	
6203322			?-10-1956	
6203323			?-10-1956	
6203324			?-11-1956	† 16-3-1958 (f)
6203325			?-11-1956	
6203326			?-11-1956	
6203327			?-11-1956	
6203328			?-12-1956	
6203329			?-11-1956	
6203330	Tu-16 Tu-16B	27	?-12-1956	LII
6203401			?-11-1956	
6203402			?-12-1956	
6203403			?-12-1956	
6203404	Tu-16KS	M 16... (Indonesian AF)	?-12-1956	
6203405			?-12-1956	
6203406			?-12-1956	
6203407			?-12-1956	
6203408	Tu-16A		?-12-1956	Black Sea Fleet, Gvardeyskoye AB. † 31-8-1957 nr Anapa (f)
6203409			?-12-1956	
6203410			?-12-1956	
6203411			?-12-1956	
6203412			?-12-1956	

Construction number	Version	Tactical code/ Registration	Manufacture date	Notes
6203413			?-12-1956	
6203414		08 Black	?-12-1956	
6203415	Tu-16 Tu-16KSR-2-5	26 Blue	?-1-1957	
6203416			?-12-1956	
6203417			?-12-1956	
6203418			?-12-1956	
7203419			?-2-1957	
7203420			?-2-1957	
7203421			?-1-1957	
7203422			?-1-1957	
7203423			?-2-1957	† 12-2-1958 Ostrov AB (f)
7203424			?-2-1957	
7203425			?-1-1957	
7203426			?-2-1957	
7203427	Tu-16KS?	M 1625 (Indonesian AF)?	?-2-1957	Marked 63427 on tail!
7203428	Tu-16A Tu-16N	02 Red	?-2-1957	
7203429			?-2-1957	
7203430			?-2-1957	
7203501			?-2-1957	
7203502			?-2-1957	
7203503			?-3-1957	
7203504			?-2-1957	
7203505			?-2-1957	
7203506			?-2-1957	
7203507			?-2-1957	
7203508			?-2-1957	
7203509			?-2-1957	
7203510			?-2-1957	† 13-1-1959 (f)?
7203511			?-3-1957	
7203512			?-3-1957	
7203513			?-3-1957	
7203514	Tu-16A with 'ECM tail'	34 Red	?-3-1957	SPS-100 & SPS-5 refit
7203515			?-3-1957	
7203516			?-3-1957	
7203517			?-3-1957	
7203518			?-3-1957	
7203519			?-3-1957	
7203520			?-3-1957	
7203521			?-3-1957	
7203522			?-3-1957	
7203523			?-4-1957	
7203524	Tu-16E	30 Red	?-3-1957	
7203525			?-4-1957	
7203526			?-4-1957	
7203527			?-4-1957	
7203528			?-4-1957	
7203529			?-4-1957	
7203530			?-4-1957	
7203601			?-4-1957	Reinforced engine nacelles
7203602			?-4-1957	Reinforced engine nacelles
7203603			?-4-1957	Reinforced engine nacelles † 10-8-1957 (f)
7203604			?-4-1957	
7203605	Tu-16KSR-2 Tu-16K-26P	71 Red	?-4-1957	
7203606	Tu-16KSR-2		?-4-1957	
7203607			?-4-1957	
7203608/7124	Tu-16KS	49 Red	?-5-1957	
	Tu-16KSR-2	49 Red 21 Blue (Ukraine AF)		prototype 251st TBAP
7203609			?-5-1957	
7203610			?-5-1957	
7203611			?-6-1957	
7203612			?-5-1957	
7203613			?-5-1957	
7203614	? Tu-16K-26 Tu-16K-26P	10 Red	?-5-1957	
7203615			?-5-1957	
7203616	? M-16 Orbita	32 Red	?-5-1957	
7203617			?-5-1957	
7203618			?-6-1957	
7203619			?-5-1957	
7203620	Tu-16K-26	20 Red	?-6-1957	GK NII VVS/Akhtoobinsk
7203621			?-5-1957	
7203622			?-5-1957	
7203623			?-6-1957	
7203624	Tu-16A Tu-16K-26 with 'ECM tail'	19 Red (Ukraine AF)	?-6-1957	251st TBAP
7203625			?-6-1957	
7203626			?-6-1957	† 8-8-1960 (f)
7203627			?-6-1957	
7203628			?-6-1957	
7203629			?-6-1957	
7203630	Tu-16KS		?-6-1957	

Construction number	Version	Tactical code/ Registration	Manufacture date	Notes
7203701			?-6-1957	
7203702			?-6-1957	
7203703			?-6-1957	
7203704			?-6-1957	
7203705			?-6-1957	
7203706			?-6-1957	
7203707			?-6-1957	
7203708			?-8-1957	
7203709			?-8-1957	
7203710			?-7-1957	
7203711			?-7-1957	
7203712		73 Red (Ukraine AF)	?-7-1957	251st TBAP
7203713			?-8-1957	
7203714			?-8-1957	
7203715			?-7-1957	
7203716			?-7-1957	
7203717			?-7-1957	
7203718			?-8-1957	
7203719			?-8-1957	
7203720			?-8-1957	
7203721			?-9-1957	
7203722	Tu-16A Tu-16K-11-16 Tu-16K-26	70 Red	?-8-1957	
7203723			?-8-1957	
7203724		07 Red (Ukraine AF)	?-8-1957	WFU Kiev-Gostomel'
7203725	Tu-16K-16	21 Black	?-8-1957	
7203726			?-8-1957	
7203727			?-8-1957	
7203728			?-8-1957	
7203729			?-8-1957	
7203730/7153	Tu-16KS	62 Red	?-8-1957	
7203801			?-8-1957	
7203802			?-8-1957	
7203803			?-8-1957	
7203804			?-9-1957	
7203805	Tu-16K-10	no code	?-9-1957	First prototype
7203806	Tu-16K-10	no code; 74 Red?	?-12-1957	Second prototype
7203807			?-9-1957	
7203808			?-9-1957	
7203809			?-9-1957	
7203810	? Tu-16K-26	06 Red	?-9-1957	RBP-6 Lyustra & PRS-2 Argon-2 radars
7203811			?-9-1957	
7203812			?-9-1957	
7203813			?-9-1957	
7203814			?-9-1957	
7203815			?-9-1957	
7203816			?-9-1957	
7203817		10 Red (Ukraine AF)	?-9-1957	WFU Kiev-Gostomel'
7203818			?-9-1957	
7203819/7163	Tu-16KS Tu-16K-26	24 Red	?-9-1957	
7203820/7164	Tu-16KS Tu-16KSR-2	65 Red	?-9-1957	
7203821			?-9-1957	
7203822			?-9-1957	
7203823			?-9-1957	
7203824			?-9-1957	
7203825			?-9-1957	
7203826			?-10-1957	
7203827			?-10-1957	
7203828			?-10-1957	
7203829	Tu-16A (Tu-16(Z)?)	06 Red (Ukraine AF)	?-10-1957	251st TBAP
7203830			?-10-1957	
7203901			?-10-1957	
7203902			?-10-1957	
7203903		07 Red (Ukraine AF)	?-10-1957	251st TBAP
7203904			?-10-1957	
7203905			?-10-1957	
7203906			?-12-1957	
7203907	Tu-16A	15 Black; 08 Red (Ukraine AF)	?-10-1957	? 251st TBAP
7203908		26 Blue (Ukraine AF)	?-10-1957	260th TBAP, Stryy
7203909			?-10-1957	
7203910			?-11-1957	
7203911			?-12-1957	
7203912			?-11-1957	
7203913			?-10-1957	
7203914		04 Red (Ukraine AF)	?-12-1957	251st TBAP
7203915			?-11-1957	
7203916			?-12-1957	
7203917			?-11-1957	
7203918			?-12-1957	
7203919			?-12-1957	
7203920/7182	Tu-16KSR-2-5	25 Red	?-12-1957	'order 476'
7203921			?-12-1957	
7203922			?-12-1957	
7203923			?-12-1957	

Construction number	Version	Tactical code/ Registration	Manufacture date[1]	Notes
7203924			?-12-1957	
7203925			?-12-1957	
7203926			?-12-1957	
7203927			?-12-1957	
7203928			?-12-1957	
7203929			?-12-1957	
7203930			?-12-1957	'order 476'
7204001			?-12-1957	
7204002			?-12-1957	† 5-6-1958 (nf)
7204003		17 Red (Ukraine AF)	?-12-1957	251st TBAP
7204004			?-12-1957	
7204005		18 Red (Ukraine AF)	?-12-1957	'order 476'; 251st TBAP
7204006			?-12-1957	'order 476'
7204007			?-12-1957	'order 476'
8204008	Tu-16 Yolka		?-1-1958	
	Tu-16P Buket	06 Red		
8204009	Tu-16P Buket	08 Red	?-1-1958	
		99 Red		
8204010	Tu-16K-10	54 Red	?-4-1958	1st production aircraft
8204011			?-1-1958	
8204012			?-2-1958	
8204013			?-1-1958	
8204014			?-2-1958	
8204015			?-2-1958	
8204016	Tu-16P Buket	96 Red	?-1-1958	
8204017			?-2-1958	
8204018			?-3-1958	
8204019			?-2-1958	
8204020			?-3-1958	
8204021			?-3-1958	
8204022/8191	Tu-16A	54 Red	?-2-1958	
	Tu-16K-11-16			
	Tu-16K-26			GIA Kiev Air Force Institute
8204023			?-2-1958	† 5-11-1960 (f)
8204024			?-2-1958	
8204025			?-3-1958	
8204026	?, Tu-16KRM		?-3-1958	
8204027			?-3-1958	
8204028			?-3-1958	
8204029	Tu-16K-10(ZA)		?-8-1958	
8204030			?-3-1958	
8204101			?-3-1958	
8204102	Tu-16A(ZA)		?-3-1958	
8204103	Tu-16K-10(ZA)		?-12-1958	
8204104			?-4-1958	'order 261'
8204105			?-4-1958	'order 226'
	Tu-16LL	05 Blue		LII
8204106			?-4-1958	
8204107			?-4-1958	
8204108	Tu-16E	23 Red;	?-4-1958	
	M-16-3	90 Red		
8204109			?-4-1958	
8204110	Tu-16K-...		?-4-1958	
8204111/8211	Tu-16(ZA)	16 Red	?-4-1958	
	Tu-16KSR-2-5			prototype
	Tu-16KRM			
8204112			?-4-1958	
8204113			?-4-1958	
8204114			?-4-1958	
8204115			?-4-1958	
8204116			?-5-1958	
8204117			?-4-1958	'order 226'
8204118			?-5-1958	
8204119			?-4-1958	
8204120			?-5-1958	
8204121			?-5-1958	
8204122			?-5-1958	
8204123			?-5-1958	
8204124			?-5-1958	
8204125			?-5-1958	
8204126			?-5-1958	
8204127			?-6-1958	
8204128			?-5-1958	
8204129			?-6-1958	
8204130	Tu-16P	47 Red	?-6-1958	
8204201			?-6-1958	† 5-11-1960 Zyabrovka (f)
8204202			?-6-1958	
8204203	Tu-16E Azaliya/'ECM tail'	90 Red	?-6-1958	
	M-16-2	77 Red (Russian AF)		GK NI VVS/Akhtoobinsk
8204204			?-6-1958	
8204205			?-6-1958	
8204206			?-6-1958	
8204207			?-6-1958	
8204208			?-6-1958	
8204209			?-6-1958	
8204210	Tu-16SPS	39 Red (Ukraine AF)	?-7-1958	251st TBAP
8204211			?-7-1958	† 10-10-1959 (f)
8204212	Tu-16P Fikus	80 Red	?-7-1958	
	M-16-3			
8204213	Tu-16 Yolka (ZA)		?-7-1958	
8204214	Tu-16E Azaliya/'ECM tail'	69 Red	?-7-1958	
8204215			?-8-1958	
8204216	Tu-16K-10(ZA)	09	?-12-1958	
8204217			?-8-1958	
8204218			?-8-1958	
8204219	Tu-16P Buket	06	?-8-1958	
8204220			?-9-1958	
8204221			?-9-1958	
8204222	Tu-16K-10(ZA)		?-12-1958	

System 2: '15 Red', c/n 2.**74.3.05**.4 = Batch 74, manufactured in 1963, fifth aircraft in the batch; the first and last digits are meaningless.

Construction number	Fuselage number	Version	Tactical code/	Manufacture date[1]	Notes
	5101	Tu-16K-10(ZA)		?-6-1961; ?-12-1961	Damaged 20-6-1961; repaired and redelivered!
	5102	Tu-16K-10		?-6-1961	
	5103	Tu-16K-10		?-7-1961	
	5104	Tu-16K-10		?-8-1961	
	5105	Tu-16K-10		?-7-1961	
	5201	Tu-16K-10		?-8-1961	
	5202	Tu-16K-10		?-8-1961	† 18-4-1956 Priluki
	5203	Tu-16K-10		?-9-1961	
	5204	Tu-16K-10		?-8-1961	
	5205	Tu-16K-10		?-9-1961	
	5301	Tu-16K-10		?-?-1961	
	5302	Tu-16K-10		?-9-1961	
	5303	Tu-16K-10		?-9-1961	
	5304	Tu-16K-10		?-9-1961	
	5305	Tu-16K-10		?-9-1961	
	5401	Tu-16K-10		?-10-1961	
	5402	Tu-16K-10		?-10-1961	
	5403	Tu-16K-10		?-10-1961	
	5404	Tu-16K-10		?-10-1961	
	5405	Tu-16K-10		?-10-1961	
	5501	Tu-16K-10		?-10-1961	
2551023	5502	Tu-16K-10		?-11-1961	
	5503	Tu-16K-10		?-11-1961	
	5504	Tu-16K-10		?-11-1961	
	5505	Tu-16K-10		?-11-1961	
	5601	Tu-16K-10		?-12-1961	
2561024	5602	Tu-16K-10	04 Red (Ukraine AF)	?-12-1961	
	5603	Tu-16K-10		?-12-1961	
	5604	Tu-16K-10		?-12-1961	
	5605	Tu-16K-10		?-12-1961	
	5701	Tu-16K-10		?-2-1962	
	5702	Tu-16K-10		?-2-1962	
	5703	Tu-16K-10		?-2-1962	
	5704	Tu-16K-10		?-2-1962	
	5705	Tu-16K-10		?-2-1962	
	5801	Tu-16K-10		?-3-1962	
	5802	Tu-16K-10		?-2-1962	
	5803	Tu-16K-10		?-3-1962	
	5804	Tu-16K-10		?-2-1962	
	5805	Tu-16K-10		?-3-1962	
	5901	Tu-16K-10		?-3-1962	
	5902	Tu-16K-10		?-3-1962	
	5903	Tu-16K-10		?-3-1962	
	5904	Tu-16K-10		?-3-1962	
	5905	Tu-16K-10		?-3-1962	
	6001	Tu-16K-10		?-4-1962	
	6002	Tu-16K-10		?-4-1962	
	6003	Tu-16K-10		?-4-1962	
	6004	Tu-16K-10		?-4-1962	
	6005	Tu-16K-10		?-4-1962	
	6101	Tu-16K-10		?-4-1962	
	6102	Tu-16K-10		?-5-1962	
	6103	Tu-16K-10		?-5-1962	
	6104	Tu-16K-10		?-5-1962	Pacific Fleet † nr Khorol' AB
	6105	Tu-16K-10		?-5-1962	
	6201	Tu-16K-10		?-5-1962	
	6202	Tu-16K-10		?-5-1962	
	6203	Tu-16K-10		?-6-1962	
	6204	Tu-16K-10		?-6-1962	
	6205	Tu-16K-10		?-6-1962	

Construction number	Fuselage number	Version	Tactical code/	Manufacture date[1]	Notes
	6301	Tu-16K-10		?-6-1962	
	6302	Tu-16K-10		?-6-1962	
	6303	Tu-16K-10		?-6-1962	
	6304	Tu-16K-10		?-7-1962	
	6305	Tu-16K-10		?-7-1962	
4642012	6401	Tu-16K-10		?-7-1962	
	6402	Tu-16K-10		?-7-1962	
	6403	Tu-16K-10		?-8-1962	
	6404	Tu-16K-10		?-8-1962	
	6405	Tu-16K-10		?-8-1962	
4652012	6501	Tu-16K-10		?-8-1962	
	6502	Tu-16K-10		?-8-1962	
4651034?	6503	Tu-16K-10 Tu-16K-10-26	41 Red	?-8-1962	First digit missing on aircraft
4652042	6504	Tu-16K-10		?-8-1962	
	6505	Tu-16K-10		?-9-1962	
	6601	Tu-16K-10		?-9-1962	
	6602	Tu-16K-10		?-9-1962	
	6603	Tu-16K-10		?-9-1962	
	6604	Tu-16K-10		?-9-1962	
	6605	Tu-16K-10		?-9-1962	
	6701	Tu-16K-10		?-9-1962	
	6702	Tu-16K-10		?-10-1962	
	6703	Tu-16K-10		?-10-1962	
	6704	Tu-16K-10		?-10-1962	
	6705	Tu-16K-10		?-10-1962	
	6801	Tu-16K-10		?-10-1962	
	6802	Tu-16K-10		?-10-1962	
	6803	Tu-16K-10		?-10-1962	
	6804	Tu-16K-10		?-11-1962	
	6805	Tu-16K-10		?-11-1962	
	6901	Tu-16K-10		?-12-1962	
	6902	Tu-16K-10		?-11-1962	
	6903	Tu-16K-10		?-12-1962	
	6904	Tu-16K-10		?-12-1962	
	6905	Tu-16K-10		?-12-1962	
	7001	Tu-16K-10		?-12-1962	
	7002	Tu-16K-10		?-12-1962	
	7003	Tu-16K-10		?-12-1962	
	7004	Tu-16K-10		?-12-1962	
	7005	Tu-16K-10		?-12-1962	
	7101	Tu-16K-10		?-1-1963	
	7102	Tu-16K-10		?-1-1963	
	7103	Tu-16K-10		?-1-1963	
	7104	Tu-16K-10			
	7105	Tu-16K-10		?-1-1963	
	7201	Tu-16K-10		?-2-1963	
	7202	Tu-16K-10		?-2-1963	
	7203	Tu-16K-10		?-2-1963	
	7204	Tu-16K-10		?-2-1963	
	7205	Tu-16K-10		?-2-1963	
	7301	Tu-16K-10		?-2-1963	
	7302	Tu-16K-10		?-3-1963	
	7303	Tu-16K-10		?-3-1963	
	7304	Tu-16K-10		?-3-1963	
	7305	Tu-16K-10		?-3-1963	
	7401	Tu-16K-10		?-4-1963	
	7402	Tu-16K-10		?-4-1963	
	7403	Tu-16K-10		?-4-1963	
	7404	Tu-16K-10			
2743054	7405	Tu-16K-10 Tu-16K-10D Tu-16K-10-26		?-5-1963	
	7501	Tu-16K-10		?-4-1963	
	7502	Tu-16K-10		?-5-1963	
	7503	Tu-16K-10		?-5-1963	
	7504	Tu-16K-10		?-6-1963	
	7505	Tu-16K-10		?-5-1963	
	7601	Tu-16K-10		?-6-1963	
	7602	Tu-16K-10		?-6-1963	
	7603	Tu-16K-10		?-6-1963	
	7604	Tu-16K-10		?-6-1963	
	7605	Tu-16K-10		?-7-1963	
	7701	Tu-16K-10		?-7-1963	
	7702	Tu-16K-10		?-7-1963	
	7703	Tu-16K-10		?-7-1963	
	7704	Tu-16K-10		?-7-1963	
	7705	Tu-16K-10		?-8-1963	
	7801	Tu-16K-10		?-8-1963	
	7802	Tu-16K-10		?-8-1963	
	7803	Tu-16K-10		?-8-1963	
	7804	Tu-16K-10		?-9-1963	
	7805	Tu-16K-10		?-9-1963	
1793014	7901	Tu-16K-10 Tu-16K-10-26	15 Red	?-10-1963	
	7902	Tu-16K-10		?-10-1963	
	7903	Tu-16K-10		?-10-1963	
	7904	Tu-16K-10		?-10-1963	
	7905	Tu-16K-10		?-11-1963	
	8001	Tu-16K-10		?-11-1963	
	8002	Tu-16K-10		?-10-1963	
	8003	Tu-16K-10		?-11-1963	
	8004	Tu-16K-10		?-12-1963	
	8005	Tu-16K-10		?-12-1963	

Kuibyshev Aircraft Factory No 1

'10 Red', c/n 1.88.11.10 = plant No 1, *izdeliye* 88, Batch 11, 10th aircraft in the batch

Construction number	Version	Tactical code/ Registration	Manufacture date[1]	Notes
1880001	Tu-16 Tu-16(Z)		?-10-1954	Built from components of c/n 4200505; Tupolev OKB
1880002	Tu-16		?-11-1954	
1880101	Tu-16 Tu-16(Z)	57 Red, 24 Red	?-10-1954	Tupolev OKB LII, avionics testbed
1880201	Tu-16 Tu-16(Z)		?-11-1954	GK NII VVS
1880202	Tu-16		?-12-1954	
1880301	Tu-16 Tu-16(Z)		?-12-1954	
1880302	Tu-16 Tu-16R-1 Tu-16R-2	50 Red	?-12-1954	Preserved Russian AF Museum
1880401	Tu-16		?-12-1954	
1880402	Tu-16		?-12-1954	?? TBAP, Kiev-Borispol'
1880403	Tu-16 Tu-16LL	?	?-12-1954	LII
1880404			?-2-1955	
1880405			?-2-1955	
1880501			?-2-1955	
1880502			?-2-1955	
1880503			?-2-1955	
1880504			?-3-1955	
1880505			?-3-1955	
1880601			?-3-1955	
1880602		76 Black	?-3-1955	?? TBAP, Dyaghilevo AB. † 20-2-1958 (f)
1880603			?-3-1955	
1880604			?-3-1955	
1880605			?-3-1955	
1880701			?-3-1955	185th TBAP, Poltava. † ?-6-1956 (f)
1880702			?-3-1955	
1880703			?-3-1955	
1880704			?-4-1955	
1880705			?-4-1955	
1880801		76	?-4-1955	
1880802			?-4-1955	185th TBAP, Poltava. † 19-8-1955 (f)
1880803	Tu-16SPS		?-4-1955	
1880804		01	?-4-1955	
1880805			?-4-1955	
1880901		14 Red	?-5-1955	
1880902			?-5-1955	
1880903			?-5-1955	
1880904	Tu-16SPS	09 Blue	?-5-1955	
1880905			?-5-1955	
1881001			?-5-1955	
1881002			?-5-1955	
1881003			?-5-1955	
1881004			?-5-1955	402nd TBAP, Balbasovo AB † 8-12-1959 (f)?
1881005			?-6-1955	

Construction number	Version	Tactical code/ Registration	Manufacture date[1]	Notes
1881101			?-6-1955	
1881102			?-6-1955	† 23-12-1958 (f)?
1881103			?-6-1955	
1881104			?-6-1955	
1881105			?-6-1955	
1881106			?-6-1955	
1881107			?-6-1955	
1881108			?-6-1955	
1881109			?-6-1955	
1881110			?-6-1955	
	Tu-16LL	10 Red		LII
1881201			?-7-1955	
1881202			?-7-1955	
1881203			?-7-1955	
1881204			?-7-1955	
1881205			?-7-1955	
1881206			?-7-1955	
1881207			?-7-1955	
1881208			?-7-1955	
1881209			?-7-1955	† 15-7-1957 (f)
1881210		19 Red	?-7-1955	GK NII VVS/Akhtoobinsk
1881301	Tu-16		?-7-1955	
	Tu-16G	CCCP-Л5411		
1881302			?-8-1955	
1881303			?-7-1955	
1881304		58 Red	?-9-1955	GIA Kiev Institute of Civil Aviation Engineers
1881305	Tu-16SPS	42 Red	?-7-1955	
	Tu-16P Buket/'ECM tail'			
1881306			?-9-1955	
1881307			?-9-1955	
1881308			?-9-1955	
1881309			?-9-1955	
1881310			?-9-1955	
1881401			?-9-1955	
1881402			?-9-1955	
1881403	Tu-16		?-9-1955	
1881404			?-8-1955	
1881405			?-9-1955	
1881406			?-8-1955	
1881407		43 Red	?-9-1955	
1881408			?-9-1955	
1881409			?-9-1955	
1881410	Tu-16SPS	34 Blue	?-9-1955	
	Tu-16P Buket			
1881501			?-9-1955	
1881502			?-9-1955	
1881503			?-9-1955	
1881504			?-8-1955	
1881505			?-9-1955	
1881506			?-8-1955	
1881507			?-9-1955	
1881508			?-9-1955	
1881509			?-9-1955	
1881510			?-9-1955	
1881601			?-9-1955	
1881602	Tu-16P	10 Red	?-9-1955	
1881603			?-9-1955	
1881604			?-10-1955	
1881605	Tu-16 Yolka	23 Blue	?-10-1955	
1881606			?-10-1955	
1881607			?-10-1955	
1881608			?-10-1955	
1881609			?-10-1955	
1881610			?-10-1955	
1881701			?-11-1955	
1881702			?-11-1955	
1881703	Tu-16		?-10-1955	Mfd this date as Tu-16
	Tu-16SPS		?-11-1955	Mfd this date as Tu-16SPS
1881704	Tu-16		?-10-1955	Mfd this date as Tu-16
	Tu-16SPS		?-11-1955	Mfd this date as Tu-16SPS
1881705	Tu-16		?-10-1955	Mfd this date as Tu-16
	Tu-16SPS		?-11-1955	Mfd this date as Tu-16SPS
1881706	Tu-16		?-10-1955	Mfd this date as Tu-16
	Tu-16SPS		?-11-1955	Mfd this date as Tu-16SPS
1881707	Tu-16		?-10-1955	Mfd this date as Tu-16
	Tu-16SPS		?-11-1955	Mfd this date as Tu-16SPS
1881708	Tu-16		?-10-1955	Mfd this date as Tu-16
	Tu-16SPS	40	?-11-1955	Mfd this date as Tu-16SPS
	M-16-1			
1881709	Tu-16		?-10-1955	Mfd this date as Tu-16
	Tu-16SPS		?-11-1955	Mfd this date as Tu-16SPS
1881710	Tu-16		?-10-1955	Mfd this date as Tu-16
	Tu-16SPS		?-11-1955	Mfd this date as Tu-16SPS
1881801			?-11-1955	
1881802			?-11-1955	
1881803			?-11-1955	
1881804			?-11-1955	
1881805			?-11-1955	
1881806			?-11-1955	
1881807			?-12-1955	
1881808			?-12-1955	
1881809	Tu-16R	12 Red	?-12-1955	GK NII VVS/Akhtoobinsk
1881810			?-12-1955	
1881901			?-12-1955	† 13-3-1959 (f)
1881902			?-12-1955	
1881903			?-12-1955	
1881904			?-12-1955	
1881905			?-12-1955	
1881906			?-12-1955	
1881907	Tu-16	46 Red	?-12-1955	
1881908			?-12-1955	
1881909			?-12-1955	
1881910			?-12-1955	
1882001			?-12-1955	
1882002			?-12-1955	
1882003			?-12-1955	
1882004			?-12-1955	
1882005			?-12-1955	
1882006			?-12-1955	
1882007			?-12-1955	
1882008			?-12-1955	
1882009			?-12-1955	
1882010			?-2-1956	
1882011			?-2-1956	
1882012			?-2-1956	
1882013			?-2-1956	
1882014			?-2-1956	
1882015			?-2-1956	
1882016			?-?-1956	
1882017			?-2-1956	
1882018				
1882019			?-2-1956	
1882020			?-2-1956	
1882101				
1882102			?-2-1956	
1882103			?-2-1956	
1882104			?-3-1956	
1882105			?-3-1956	
1882106	Tu-16 Fonar'			
1882107			?-3-1956	
1882108	Tu-16(Z)	26 Red	?-3-1956	
1882109			?-3-1956	
1882110			?-3-1956	
1882111			?-3-1956	
1882112			?-3-1956	
1882113			?-3-1956	
1882114			?-3-1956	
1882115			?-3-1956	
1882116			?-3-1956	
1882117			?-3-1956	
1882118			?-3-1956	
1882119			?-3-1956	
1882120			?-3-1956	
1882201			?-4-1956	
1882202	Tu-16		?-4-1956	
	Tu-16N			
1882203			?-4-1956	
1882204			?-4-1956	
1882205	Tu-16P Buket	28; 01 Red	?-4-1956	Gate guard Shaikovka AB
1882206			?-5-1956	
1882207			?-5-1956	
1882208			?-5-1956	
1882209			?-5-1956	
1882210			?-5-1956	
1882211			?-5-1956	
1882212			?-5-1956	
1882213			?-9-1956	'order 198'; 184th TBAP, Priluki. † 17-8-1957 (f)
1882214			?-9-1956	'order 198'
1882215			?-5-1956	
1882216	Tu-16E Azaliya	61 Red	?-5-1956	
	Tu-16P Buket			
	M-16-3			
1882217			?-5-1956	
1882218			?-5-1956	
1882219			?-5-1956	
1882220			?-5-1956	
1882301			?-5-1956	
1882302	Tu-16R	30 Blue?		
	Tu-16NN	41 Red/41 Blue	?-5-1956	
1882303			?-5-1956	
1882304			?-5-1956	
1882305	Tu-16R Romb		?-6-1956	

Construction number	Version	Tactical code/ Registration	Manufacture date	Notes
1882306	Tu-16 Yolka	09 Red	?-5-1956	
1882307			?-6-1956	
1882308			?-6-1956	
1882309	Tu-16R?	30 Red?	?-5-1956	† 6-10-1956 (f)
1882310			?-6-1956	'order 198'
1882311			?-6-1956	† 3-7-1959 (f)
1882312			?-6-1956	
1882313			?-6-1956	
1882314	Tu-16 Tu-16N		?-6-1956	
1882315			?-6-1956	
1882316			?-8-1956	
1882317			?-7-1956	
1882318			?-6-1956	
1882319			?-6-1956	
1882320			?-6-1956	
1882401	Tu-16 Tu-16N		?-7-1956	prototype
1882402			?-7-1956	
1882403			?-7-1956	
1882404			?-7-1956	
1882405	Tu-16R	33 Blue	?-7-1956	
1882406			?-7-1956	
1882407			?-7-1956	
1882408	Tu-16SPS Tu-16P Buket		?-7-1956	
1882409	Tu-16SPS Tu-16P Fikus/'ECM tail'		?-7-1956	
1882410			?-10-1956	
1882411	Tu-16E	45 Red	?-8-1956	
1882412			?-8-1956	
1882413			?-8-1956	
1882414			?-8-1956	
1882415			?-9-1956	
1882416			?-8-1956	
1882417			?-8-1956	
1882418			?-8-1956	
1882419			?-8-1956	
1882420	Tu-16R		?-8-1956	
1882501			?-9-1956	
1882502			?-9-1956	
1882503	Tu-16 Tu-16N Tu-16NN	45 Blue	?-9-1956	
1882504			?-9-1956	† 14-10-1959 (f)
1882505			?-9-1956	
1882506			?-9-1956	
1882507			?-9-1956	
1882508			?-10-1956	
1882509			?-10-1956	
1882510			?-10-1956	
1882511			?-10-1956	
1882512			?-10-1956	
1882513			?-10-1956	
1882514			?-11-1956	
1882515	Tu-16E	78	?-10-1956	
1882516			?-11-1956	
1882517			?-10-1956	
1882518			?-11-1956	
1882519			?-10-1956	
1882520			?-11-1956	
1882601			?-11-1956	
1882602			?-11-1956	
1882603			?-12-1956	
1882604			?-11-1956	
1882605			?-12-1956	
1882606			?-11-1956	
1882607			?-12-1956	
1882608			?-12-1956	
1882609			?-12-1956	
1882610			?-12-1956	
1882611			?-12-1956	
1882612	Tu-16R?	21 Blue	?-12-1956	Gate guard Priluki AB
1882613			?-12-1956	
1882614			?-12-1956	
1882615	Tu-16SPS	20 Red	?-12-1956	
1882616			?-12-1956	
1882617			?-12-1956	
1882618			?-12-1956	
1882619			?-12-1956	
1882620			?-1-1957	
1882701			?-1-1957	
1882702			?-1-1957	
1882703			?-1-1957	
1882704			?-1-1957	
1882705			?-1-1957	
1882706			?-1-1957	
1882707			?-1-1957	
1882708		27	?-1-1957	?? TBAP, Spassk-Dal'niy † 21-2-1984 Spassk-Dal'niy (f)

Construction number	Version	Tactical code/ Registration	Manufacture date	Notes
1882709			?-1-1957	
1882710	Tu-16R	26 Red	?-1-1957	
1882711			?-2-1957	
1882712			?-2-1957	
1882713			?-2-1957	† 25-6-1957 (f)
1882714			?-2-1957	
1882715			?-2-1957	
1882716			?-2-1957	
1882717			?-2-1957	
1882718			?-2-1957	
1882719			?-2-1957	
1882720			?-2-1957	
1882801	Tu-16 Tu-16(Z)	30 Black	?-2-1957	
1882802			?-3-1957	
1882803			?-3-1957	
1882804			?-3-1957	
1882805			?-4-1957	
1882806			?-3-1957	
1882807			?-3-1957	
1882808			?-3-1957	LII; testbed with RD-3MR engines
1882809			?-3-1957	† 12-9-1958 Migalovo AB (f)
1882810			?-3-1957	
1882811			?-3-1957	
1882812			?-3-1957	
1882813			?-3-1957	
1882814			?-3-1957	
1882815			?-4-1957	
1882816			?-4-1957	
1882817			?-4-1957	
1882818			?-4-1957	
1882819			?-4-1957	
1882820		16	?-4-1957	
1882901			?-4-1957	
1882902			?-4-1957	
1882903			?-4-1957	
1882904			?-4-1957	
1882905			?-4-1957	
1882906	Tu-16 Tu-16(Z)		?-5-1957	
1882907	Tu-16 Tu-16(Z)		?-5-1957	
1882908	Tu-16 Tu-16(Z)		?-5-1957	
1882909	Tu-16 Tu-16(Z)		?-5-1957	
1882910			?-5-1957	
1882911			?-4-1957	
1882912			?-5-1957	
1882913			?-5-1957	
1882914			?-5-1957	† ?-11-1957 (f) shot down by Air Defence Force MiG-19
1882915			?-5-1957	
1882916			?-5-1957	
1882917	Tu-16 Tu-16(Z)	33 Red	?-5-1957	
1882918			?-6-1957	
1882919			?-6-1957	
1882920			?-6-1957	
1883001			?-9-1957	Reinforced engine nacelles
1883002			?-6-1957	Reinforced engine nacelles
1883003			?-6-1957	Reinforced engine nacelles
1883004			?-11-1957	Reinforced engine nacelles
1883005	Tu-16 Tu-16(Z)		?-6-1957	Reinforced engine nacelles
1883006			?-6-1957	Reinforced engine nacelles
1883007			?-6-1957	Reinforced engine nacelles
1883008			?-6-1957	
1883009			?-6-1957	
1883010			?-6-1957	
1883011			?-6-1957	
1883012	Tu-16 Tu-16(Z)		?-7-1957	
1883013			?-7-1957	
1883014	Tu-16R	39 Blue	?-7-1957	
1883015			?-7-1957	
1883016			?-7-1957	
1883017			?-7-1957	
1883018			?-7-1957	
1883019			?-7-1957	
1883020			?-7-1957	
1883101	Tu-16 Tu-16(Z)		?-7-1957	
1883102			?-7-1957	
1883103			?-7-1957	
1883104			?-7-1957	
1883105			?-7-1957	
1883106			?-8-1957	
1883107			?-8-1957	

Construction number	Version	Tactical code/ Registration	Manufacture date[1]	Notes
1883108		50 Red	?-8-1957	Pres. Long-Range Aviation Museum, Dyaghilevo AB
1883109			?-8-1957	
1883110			?-8-1957	
1883111			?-8-1957	
1883112			?-8-1957	
1883113			?-8-1957	
1883114			?-8-1957	
1883115			?-8-1957	
1883116			?-8-1957	
1883117	Tu-16 Tu-16P(ZA) Fikus		?-8-1957	
1883118			?-8-1957	
1883119			?-8-1957	
1883120			?-10-1957	
1883201			?-10-1957	
1883202			?-9-1957	
1883203			?-9-1957	
1883204		12 Red	?-9-1957	
1883205			?-9-1957	
1883206			?-9-1957	
1883207		22	?-9-1957	
1883208			?-9-1957	
1883209			?-9-1957	
1883210			?-9-1957	
1883211			?-9-1957	
1883212			?-9-1957	
1883213		06	?-10-1957	
1883214			?-10-1957	
1883215	Tu-16R		?-10-1957	
1883216			?-10-1957	
1883217			?-10-1957	
1883218			?-10-1957	† 13-10-1958 (f)
1883219			?-10-1957	
1883220			?-10-1957	
1883301		29 Red	?-10-1957	
1883302		30 Red	?-10-1957	
1883303		33 Blue	?-10-1957	
1883304	Tu-16R(ZA)	12 Red, 39 Red	?-10-1957	
1883305	Tu-16R(ZA) Tu-16RR(ZA)	27 Blue, 28 Red	?-10-1957	
1883306			?-11-1957	
1883307		43 Red	?-11-1957	
1883308	Tu-16SPS(ZA) Tu-16R(ZA)	87 Red	?-11-1957	
1883309			?-11-1957	
1883310	Tu-16R	21 Black	?-11-1957	
1883311			?-11-1957	
1883312		28 Blue	?-11-1957	
1883313	Tu-16R(ZA)	35 Red, 23	?-11-1957	
1883314		23 Red	?-11-1957	GIA Kiev Institute of Civil Aviation Engineers
1883315	Tu-16R(ZA)		?-11-1957	
1883316	Tu-16R	02 Red	?-11-1957	
1883317	Tu-16R(ZA)		?-11-1957	
1883318	Tu-16R	25 Red	?-12-1957	
1883319		22 Blue	?-12-1957	
1883320			?-12-1957	
1883401			?-12-1957	
1883402		23	?-12-1957	
1883403	Tu-16R	25	?-12-1957	
1883404			?-12-1957	
1883405	Tu-16R(ZA)/'ECM tail'	05 Blue	?-12-1957	Siren' jammer
1883406			?-12-1957	
1883407			?-12-1957	
1883408	Tu-16R(ZA)	20 Red	?-12-1957	
1883409	Tu-16E	05 Blue	?-12-1957	
1883410	Tu-16SPS Tu-16R	07 Red	?-1-1958	
1883411			?-1-1958	
1883412			?-1-1958	
1883413			?-1-1958	
1883414	Tu-16R(ZA)		?-1-1958	
1883415			?-1-1958	
1883416	Tu-16R(ZA) Tu-16RR(ZA)	03 Red	?-1-1958	
1883417			?-1-1958	
1883418	Tu-16R	26 Black	?-1-1958	
1883419			?-1-1958	
1883420			?-2-1958	
1883501	Tu-16R(ZA)	44, 41 Red	?-2-1958	
1883502			?-2-1958	
1883503			?-2-1958	
1883504	Tu-16R(ZA)	44 Red	?-2-1958	
1883505			?-2-1958	
1883506		26	?-2-1958	
1883507			?-2-1958	
1883508			?-2-1958	
1883509			?-2-1958	
1883510			?-3-1958	
1883511	Tu-16R(ZA)/'ECM tail'	29 Red 04 Red/04 Black	?-3-1958	SPS-100M Mal'va jammer Preserved Dyaghilevo AB
1883512	Tu-16R		?-3-1958	
1883513			?-3-1958	
1883514			?-3-1958	
1883515			?-3-1958	
1883516			?-3-1958	
1883517			?-3-1958	
1883518			?-3-1958	
1883519			?-3-1958	
1883520			?-3-1958	
1883601		69 Red	?-3-1958	LII; scrapped Zhukovskiy
1883602			?-4-1958	
1883603			?-4-1958	
1883604			?-4-1958	
1883605			?-4-1958	
1883606	Tu-16 Yolka Tu-16P(ZA) Buket		?-4-1958	
1883607			?-4-1958	
1883608			?-4-1958	
1883609	Tu-16E Azaliya M-16-2	29	?-4-1958	
1883610			?-4-1958	
1883611			?-5-1958	
1883612			?-5-1958	† 14-11-1960 (f)
1883613			?-5-1958	
1883614			?-5-1958	
1883615			?-5-1958	
1883616			?-5-1958	
1883617			?-5-1958	
1883618			?-5-1958	
1883619			?-5-1958	
1883620				
1883701	Tu-16 Yolka M-16	18 Red (Russian AF)	?-2-1959	GK NII VVS/Akhtoobinsk
1883702	Tu-16 Yolka M-16		?-2-1959	
1883703	Tu-16 Yolka M-16		?-2-1959	
1883704	Tu-16 Yolka Tu-16KRME M-16	08 Red (Russian AF)	?-2-1959	
1883705	Tu-16 Yolka M-16		?-2-1959	
1883706	Tu-16 Yolka M-16		?-3-1959	
1883707	Tu-16 Yolka M-16		?-4-1959	
1883708	Tu-16 Yolka M-16	16 Red (Russian AF)	?-4-1959	GK NII VVS/Akhtoobinsk
1883709	Tu-16 Yolka M-16		?-5-1958	
1883710	Tu-16 Yolka M-16		?-5-1959	
1883711	Tu-16 Yolka M-16	10 Red (Russian AF)	?-5-1959	GK NII VVS/Akhtoobinsk
1883712	Tu-16 Yolka M-16		?-5-1959	
1883713	Tu-16 Yolka M-16		?-6-1959	
1883714	Tu-16K-10(ZA)		?-9-1959	
1883715	Tu-16K-10(ZA)		?-10-1959	
1883716	Tu-16K-10(ZA)		?-9-1959	
1883717	Tu-16K-10(ZA)		?-10-1959	
1883718	Tu-16K-10(ZA)		?-9-1959	
1883719	Tu-16K-10(ZA)		?-10-1959	
1883720	Tu-16K-10(ZA)		?-10-1959	
1883801	Tu-16K-10(ZA)		?-11-1959	
1883802	Tu-16K-10(ZA)		?-11-1959	
1883803	Tu-16K-10(ZA)		?-2-1960	
1883804	Tu-16K-10(ZA)		?-1-1960	
1883805	Tu-16K-10(ZA)		?-11-1959	
1883806	Tu-16K-10(ZA)		?-11-1959	
1883807	Tu-16K-10(ZA)		?-11-1959	
1883808	Tu-16K-10(ZA)		?-11-1959	
1883809	Tu-16K-10(ZA)		?-12-1959	
1883810	Tu-16K-10(ZA)		?-1-1960	
1883811	Tu-16K-10(ZA)		?-12-1959	
1883812	Tu-16K-10(ZA)		?-12-1959	
1883813	Tu-16K-10(ZA)		?-12-1959	
1883814	Tu-16K-10(ZA)		?-1-1960	
1883815	Tu-16K-10(ZA)		?-1-1960	
1883816	Tu-16K-10(ZA)		?-2-1960	
1883817	Tu-16K-10(ZA)		?-2-1960	
1883818	Tu-16K-10(ZA)		?-2-1960	
1883819	Tu-16K-10(ZA)		?-2-1960	
1883820	Tu-16K-10(ZA)	12 Red	?-2-1960	

Construction number	Version	Tactical code/ Registration	Manufacture date[1]	Notes
1883901	Tu-16K-10(ZA)		?-1-1960	
1883902	Tu-16K-10(ZA)		?-1-1960	
1883903	Tu-16K-10(ZA)		?-1-1960	
1883904	Tu-16K-10(ZA)		?-1-1960	
1883905	Tu-16K-10(ZA)	02 Red (Ukraine AF)	?-7-1960	
1883906	Tu-16K-10(ZA)		?-7-1960	
1883907	Tu-16K-10(ZA)		?-7-1960	
1883908	Tu-16K-10(ZA)		?-3-1960	
1883909	Tu-16K-10(ZA)		?-3-1960	
1883910	Tu-16K-10(ZA)		?-4-1960	
1883911	Tu-16K-10(ZA)		?-4-1960	
1883912	Tu-16K-10(ZA)		?-3-1960	
1883913	Tu-16K-10(ZA)		?-3-1960	
1883914	Tu-16K-10(ZA)		?-3-1960	
1883915	Tu-16K-10(ZA)	05 Red (Ukraine AF)	?-3-1960	
1883916	Tu-16K-10(ZA)		?-3-1960	
1883917	Tu-16K-10(ZA)		?-4-1960	
1883918	Tu-16K-10(ZA)		?-4-1960	
1883919	Tu-16K-10(ZA)		?-4-1960	
1883920	Tu-16K-10(ZA)		?-4-1960	
1884001	Tu-16K-10(ZA)	16 Red	?-4-1960	
1884002	Tu-16K-10(ZA)		?-4-1960	
1884003	Tu-16K-10(ZA)		?-4-1960	
1884004	Tu-16K-10(ZA)		?-5-1960	
1884005	Tu-16K-10(ZA)		?-5-1960	
1884006	Tu-16K-10(ZA)		?-5-1960	
1884007	Tu-16K-10(ZA)		?-5-1960	
1884008	Tu-16K-10(ZA)		?-5-1960	
1884009	Tu-16K-10(ZA)		?-5-1960	
1884010	Tu-16K-10(ZA)		?-6-1960	
1884011	Tu-16K-10(ZA)		?-6-1960	
1884012	Tu-16K-10(ZA)		?-6-1960	

Voronezh Aircraft Factory No 64

'35 Blue', c/n 7.4.021.04 = manufactured in 1957, plant No 64, Batch 21, fourth aircraft in the batch

Construction number	Version	Tactical code/ Registration	Manufacture date[1]	Notes
5400001	Tu-16		?-5-1955	
5400002	Tu-16		?-4-1955	
5400003	Tu-16		?-7-1955	
5400101	Tu-16		?-12-1955	
5400201	Tu-16T		?-8-1955	
5400202	Tu-16		?-9-1955	
5400203	Tu-16		?-8-1955	
5400204	Tu-16		?-9-1955	
5400205	Tu-16T		?-9-1955	
5400301	Tu-16		?-9-1955	
5400302	Tu-16T		?-10-1955	
5400303	Tu-16T		?-9-1955	
5400304	Tu-16T		?-10-1955	
5400305	Tu-16T		?-10-1955	
5400401	Tu-16T		?-10-1955	
5400402	Tu-16T		?-11-1955	
5400403	Tu-16T		?-11-1955	
5400404	Tu-16T		?-12-1955	
5400405	Tu-16T		?-11-1955	
5400501	Tu-16T		?-11-1955	
5400502	Tu-16T		?-12-1955	
5400503	Tu-16T		?-12-1955	
5400504	Tu-16T		?-12-1955	
5400505	Tu-16T		?-12-1955	
5400601	Tu-16T		?-12-1955	
-400602	Tu-16T		?-1-1956	
-400603	Tu-16T		?-1-1956	
-400604	Tu-16T		?-1-1956	
-400605	Tu-16T		?-1-1956	
-400701	Tu-16T		?-2-1956	
-400702	Tu-16T		?-2-1956	
-400703	Tu-16T		?-2-1956	
6400704	Tu-16T		?-2-1956	
6400705	Tu-16T		?-2-1956	
6400801	Tu-16T		?-2-1956	
6400802	Tu-16T		?-2-1956	
6400803	Tu-16T		?-3-1956	
6400804	Tu-16T		?-3-1956	
6400805	Tu-16T		?-3-1956	
6400901	Tu-16T		?-3-1956	
6400902	Tu-16T		?-3-1956	
6400903	Tu-16T Tu-16P Buket	12 Red	?-3-1956	Later used as testbed for RPZ-59 ECM rockets
6400904	Tu-16T		?-4-1956	
6400905	Tu-16T		?-5-1956	
6401001	Tu-16T		?-5-1956	
6401002	Tu-16T	16 Red	?-5-1956	
6401003	Tu-16T		?-5-1956	
6401004	Tu-16T		?-5-1956	
6401005	Tu-16T		?-5-1956	
6401101	Tu-16		?-5-1956	
6401102	Tu-16		?-5-1956	
6401103	Tu-16T			
6401104	Tu-16		?-5-1956	
6401105	Tu-16T		?-6-1956	
6401201	Tu-16		?-6-1956	† 11-12-1956 (f)
6401202	Tu-16		?-6-1956	
6401203	Tu-16		?-6-1956	
6401204	Tu-16		?-6-1956	
6401205	Tu-16		?-6-1956	
6401206	Tu-16		?-6-1956	
6401207	Tu-16		?-6-1956	
6401208	Tu-16 Tu-16KSR-2-5	14 Red	?-7-1956	GK NII VVS/Akhtoobinsk
6401209	Tu-16T		?-7-1956	
6401210	Tu-16T		?-7-1956	
6401301	Tu-16T		?-7-1956	
6401302	Tu-16T		?-7-1956	
6401303	Tu-16T		?-8-1956	
6401304	Tu-16		?-8-1956	
6401305	Tu-16T		?-8-1956	
6401306	Tu-16		?-8-1956	
6401307	Tu-16T		?-8-1956	
6401308	Tu-16T		?-8-1956	
6401309	Tu-16T		?-8-1956	?? TBAP, Skomorokhi AB † 27-7-1958 (f)
6401310	Tu-16T		?-9-1956	
6401401	Tu-16 Tu-16LL	01 Blue	?-8-1956	LII
6401402	Tu-16		?-9-1956	
6401403	Tu-16 Tu-16LL	03	?-9-1956	LII
6401404	Tu-16		?-9-1956	
6401405	Tu-16		?-9-1956	
6401406	Tu-16	no code	?-10-1956	Static test airframe
6401407	Tu-16		?-9-1956	
6401408	Tu-16 Tu-16LL	08	?-10-1956	LII
6401409	Tu-16		?-9-1956	
6401410	Tu-16 Tu-16LL	41 Blue	?-10-1956	LII
6401501	Tu-16 Tu-16LL	01 Red	?-10-1956	LII
6401502	Tu-16		?-10-1956	
6401503	Tu-16T	32 Red	?-10-1956	
6401504	Tu-16T	45 Blue	?-12-1956	
6401505	Tu-16T		?-12-1956	
6401506	Tu-16T		?-10-1956	
6401507	Tu-16		?-11-1955	
6401508	Tu-16		?-10-1955	
6401509	Tu-16		?-11-1955	
6401510	Tu-16T		?-12-1955	
6401601	Tu-16		?-11-1955	
6401602	Tu-16		?-11-1955	† 10-6-1957 (f)
6401603	Tu-16		?-11-1955	
6401604	Tu-16		?-12-1955	
6401605	Tu-16		?-11-1955	
6401606	Tu-16		?-11-1955	
6401607	Tu-16 Tu-16RT	10 Red	?-12-1956	
6401608	Tu-16		?-12-1956	
6401609	Tu-16		?-12-1956	
6401610	Tu-16		?-12-1956	
6401701	Tu-16T		?-12-1956	
6401702	Tu-16T		?-12-1956	
6401703	Tu-16T		?-12-1956	
6401704	Tu-16T		?-12-1956	
6401705	Tu-16T		?-12-1956	
6401706	Tu-16T Tu-16P Buket	21	?-12-1956	
6401707	Tu-16T		?-12-1956	
-401708			?-2-1957	
-401709			?-2-1957	
-401710			?-2-1957	

Construction number	Version	Tactical code/ Registration	Manufacture date[1]	Notes
7401801			?-2-1957	
7401802			?-2-1957	
7401803			?-2-1957	
7401804			?-2-1957	
7401805			?-3-1957	
7401806			?-3-1957	
7401807			?-3-1957	
7401808			?-3-1957	
7401809			?-3-1957	
7401810			?-3-1957	
7401901			?-4-1957	
7401902			?-4-1957	
7401903			?-4-1957	?? TBAP, Sovetskaya Gavan' † 29-1-1958 Sovetskaya Gavan' (f)
7401904			?-4-1957	
7401905			?-4-1957	
7401906			?-4-1957	
7401907			?-5-1957	
7401908			?-5-1957	
7401909			?-5-1957	
7401910			?-5-1957	
7402001	Tu-16(ZA)		?-5-1957	
7402002	Tu-16(ZA)		?-5-1957	
7402003	Tu-16(ZA)		?-6-1957	
7402004	Tu-16(ZA)		?-6-1957	
7402005	Tu-16(ZA)		?-6-1957	
7402006	Tu-16(ZA)		?-6-1957	
7402007	Tu-16(ZA)		?-6-1957	
7402008	Tu-16(ZA)		?-6-1957	
7402009	Tu-16(ZA)		?-7-1957	
7402010	Tu-16(ZA)		?-7-1957	
7402011			?-8-1957	† 3-7-1959 (f)
7402012			?-8-1957	
7402101			?-9-1957	
7402102			?-9-1957	
7402103			?-9-1957	
7402104		35 Blue	?-9-1957	
7402105			?-9-1957	
7402106			?-9-1957	
7402107			?-10-1957	
7402108			?-10-1957	
7402109			?-10-1957	
7402110			?-10-1957	
7402201			?-10-1957	
7402202			?-12-1957	
7402203			?-11-1957	
7402204			?-11-1957	
7402205			?-11-1957	
7402206			?-11-1957	
7402207			?-12-1957	
7402208			?-12-1957	
7402209			?-12-1957	
7402210			?-12-1957	

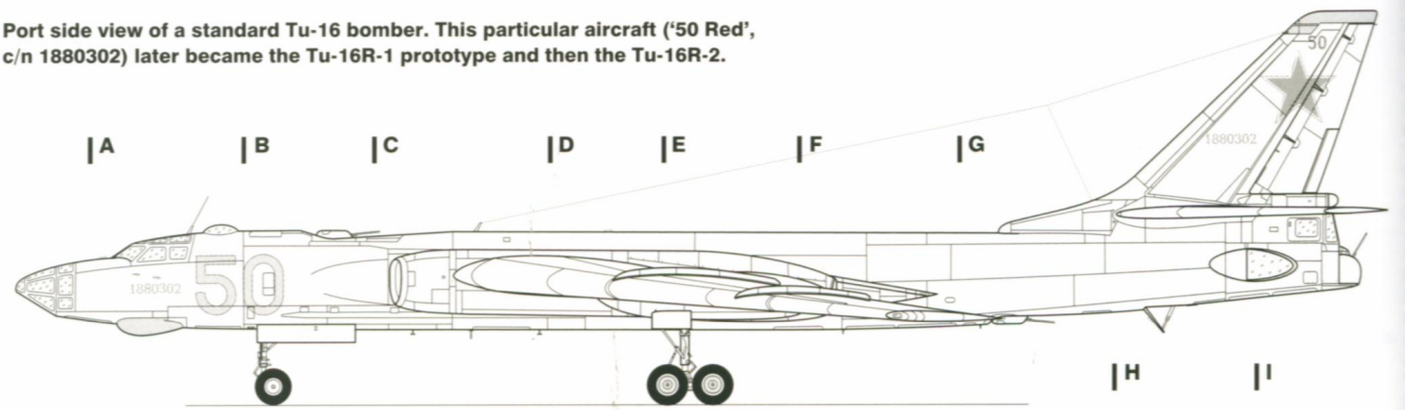
Known Xian H-6 Bombers

Serial	Construction number	Version	Notes
086 Blue		H-6	Engine testbed; later serialled '86 Blue'
10791 Blue		H-6A	
10792 Blue		H-6A	
10793 Blue?		H-6A?	
10794 Blue		H-6A	Preserved PLAAF Museum, Datangshan AB
10795 Blue		H-6A	
10796 Blue		H-6A	
10797 Blue		H-6A	
10798 Blue		H-6A	
10799 Blue?		H-6A?	
10890 Blue		H-6A	
10891 Blue		H-6A	
10892 Blue		H-6A	
10893 Blue?		H-6A?	
10894 Blue?		H-6A?	
10895 Blue		H-6A	
10896 Blue		H-6A	
10897 Blue		H-6A	
10898 Blue		H-6A	
10899 Blue?		H-6A?	
10990 Blue		H-6A	
30119 Blue		H-6A	
30210 Blue		H-6A?	
30211 Blue		H-6A	
30212 Blue?		H-6A?	
30213 Blue		H-6A	
30214 Blue?		H-6A?	
30215 Blue?		H-6A?	
30216 Blue?		H-6A?	
30217 Blue?		H-6A?	
30218 Blue		H-6A	
30219 Blue?		H-6A?	
30310 Blue		H-6A	
43499 Blue		HY-6	
43590 Blue?		HY-6?	
43591 Blue?		HY-6?	
43592 Blue?		HY-6?	
43593 Blue?		HY-6?	
43594 Blue?		HY-6?	
43595 Blue		HY-6	
50674 Blue outline		H-6A	
50675 Blue outline		H-6A	
50676 Blue?		H-6A?	
50677 Blue?		H-6A?	
50678 Blue		H-6E	Bluish grey c/s
50679 Blue		H-6E	'Nuclear' c/s, later bluish grey c/s
50770 Blue?		H-6E?	
50771 Blue?		H-6E?	
50772 Blue		H-6E	Nuclear' c/s
50773 Blue		H-6E	Nuclear' c/s
50774 Blue?		H-6E?	
50775 Blue		H-6E	Bluish grey c/s
50776 Blue		H-6E	Bluish grey c/s
50777 Blue		H-6E	Bluish grey c/s
50778 Blue		H-6E	Nuclear' c/s
61223 Blue outline		H-6D	'Nuclear' c/s, no cannon
61224 Blue outline?		H-6D?	
61225 Blue outline		H-6D	'Nuclear' c/s
?	210401	H-6H	
?	210404	H-6H	

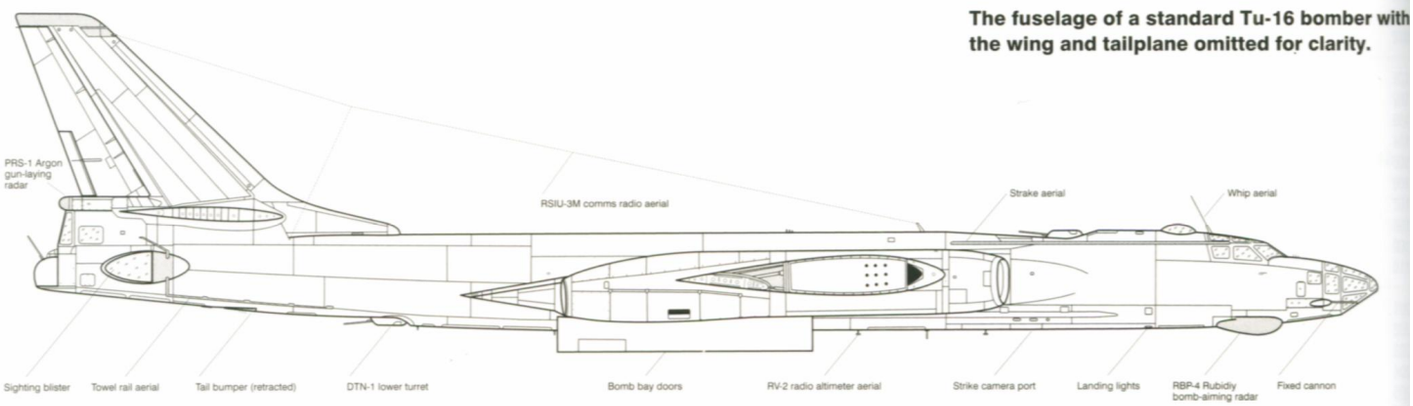
Gleaming with fresh paint, a recently overhauled Tu-16K-26 taxies out past several Soviet Air Force Antonov An-2TD utility biplanes and a single Aeroflot An-2P. Yefim Gordon archive

Tu-16 Family Drawings

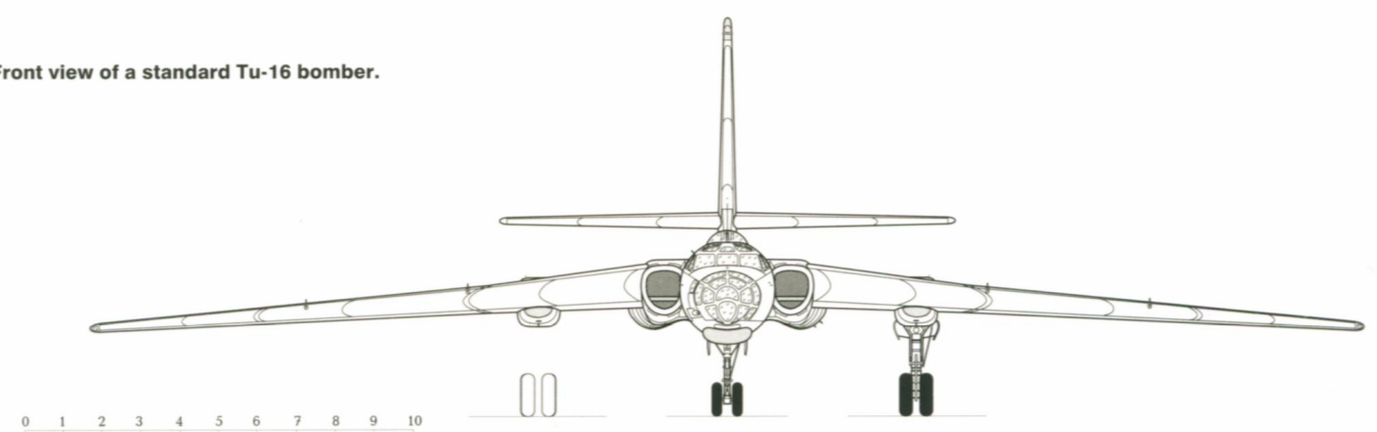
Port side view of a standard Tu-16 bomber. This particular aircraft ('50 Red', c/n 1880302) later became the Tu-16R-1 prototype and then the Tu-16R-2.



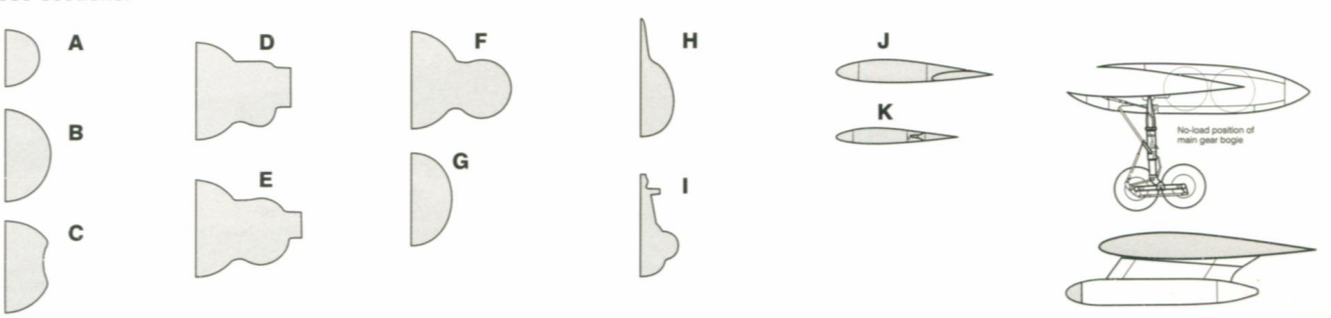
The fuselage of a standard Tu-16 bomber with the wing and tailplane omitted for clarity.



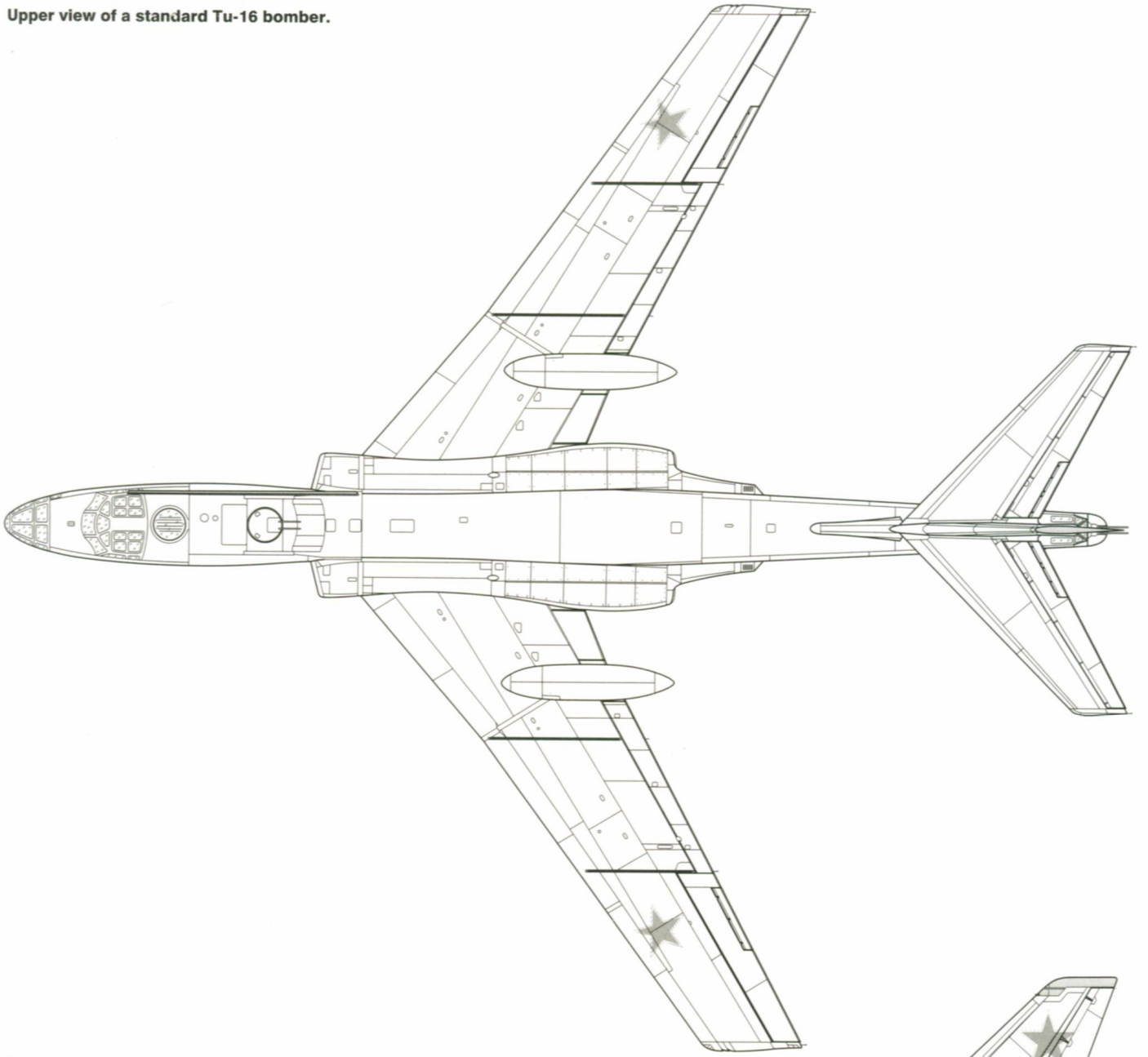
Front view of a standard Tu-16 bomber.



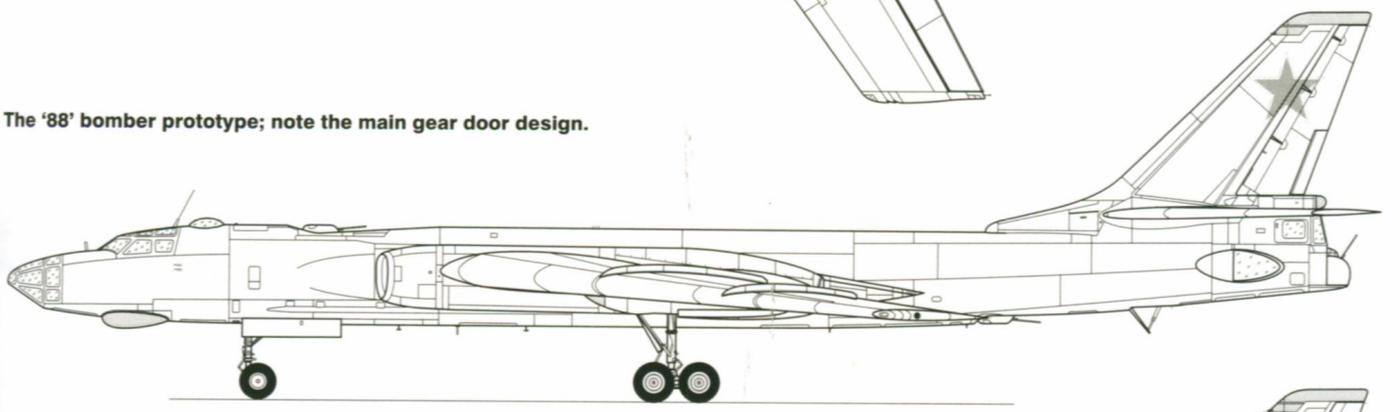
Cross-sections.



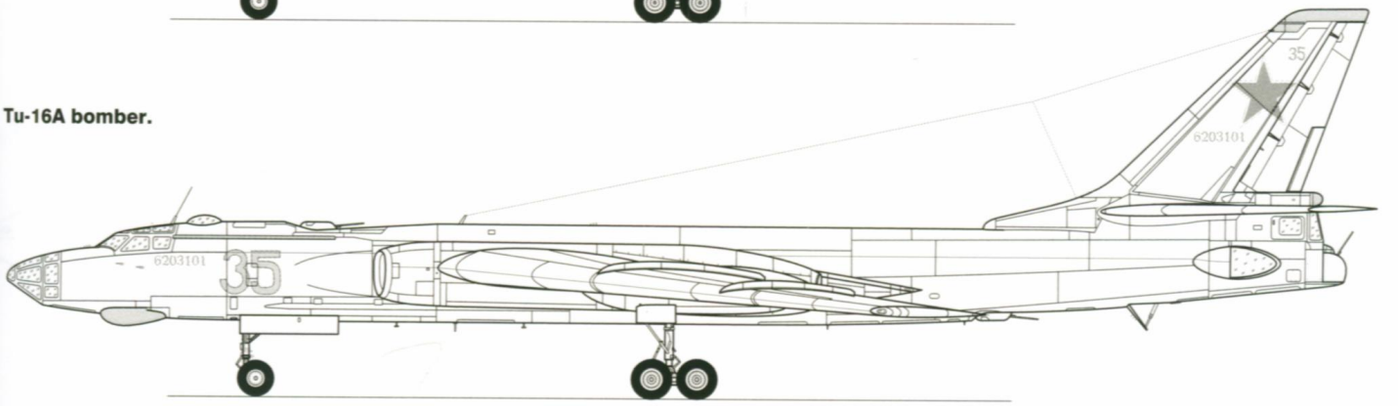
Upper view of a standard Tu-16 bomber.



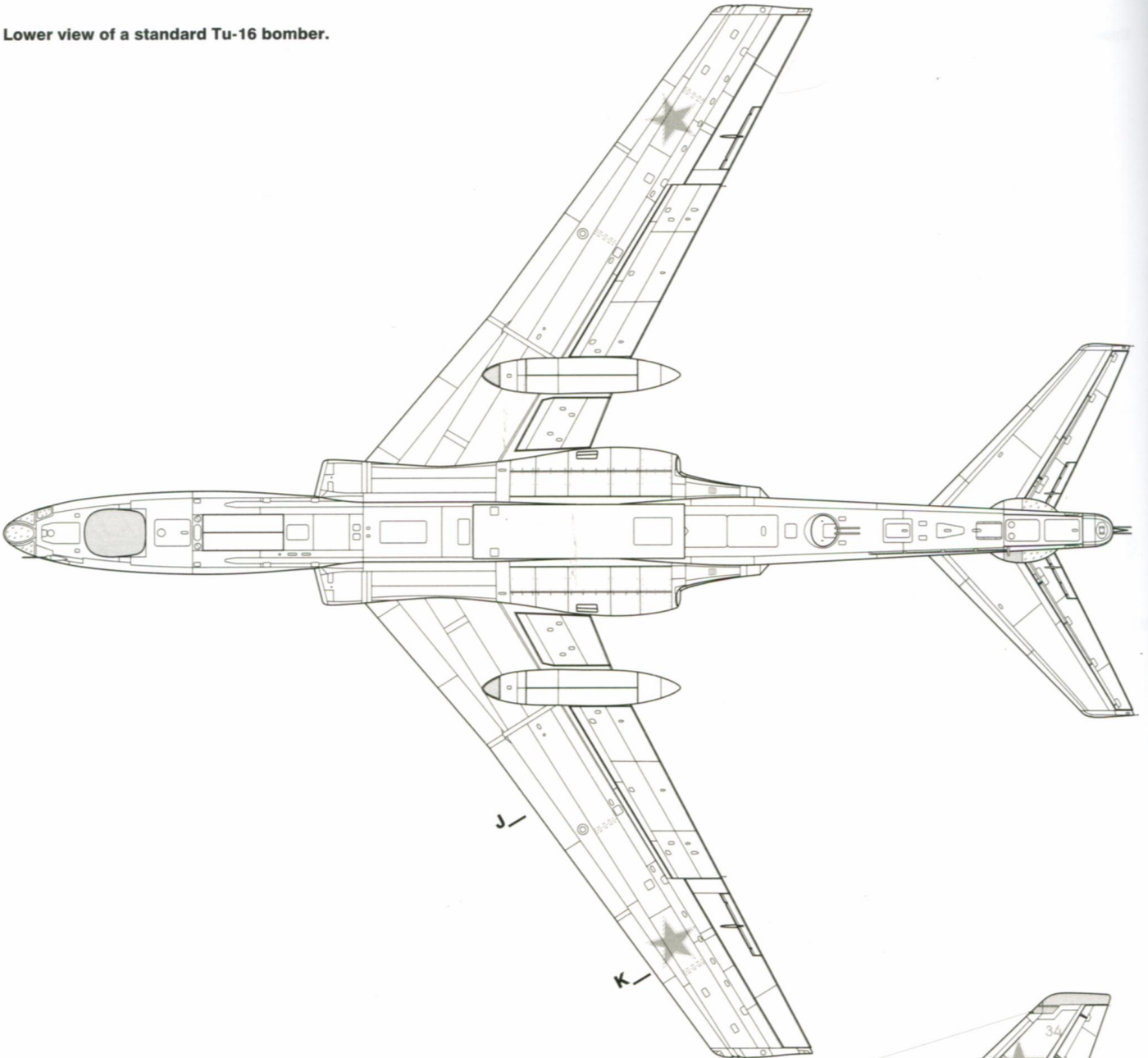
The '88' bomber prototype; note the main gear door design.



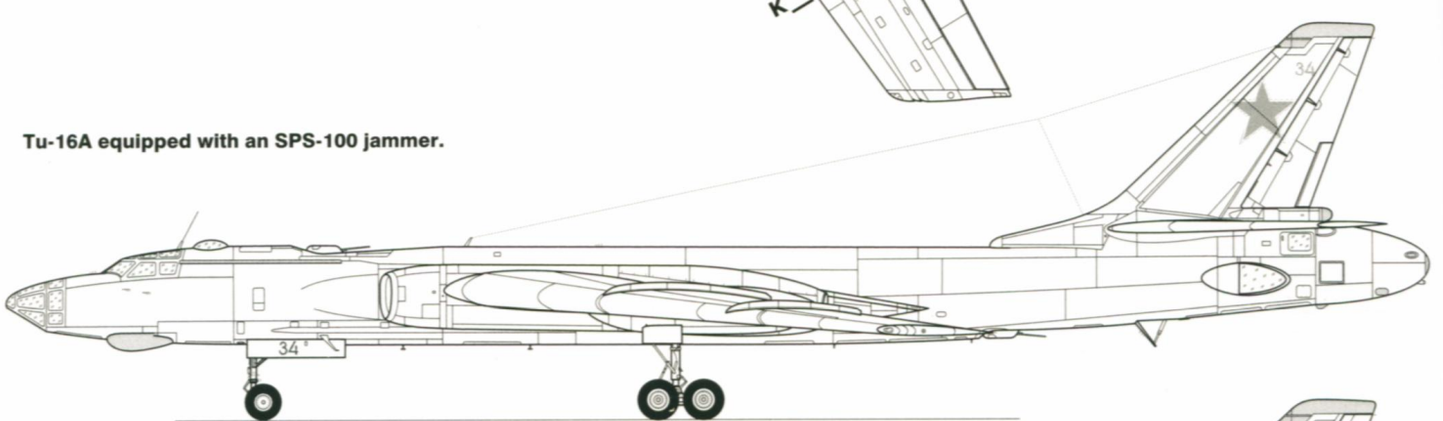
Tu-16A bomber.



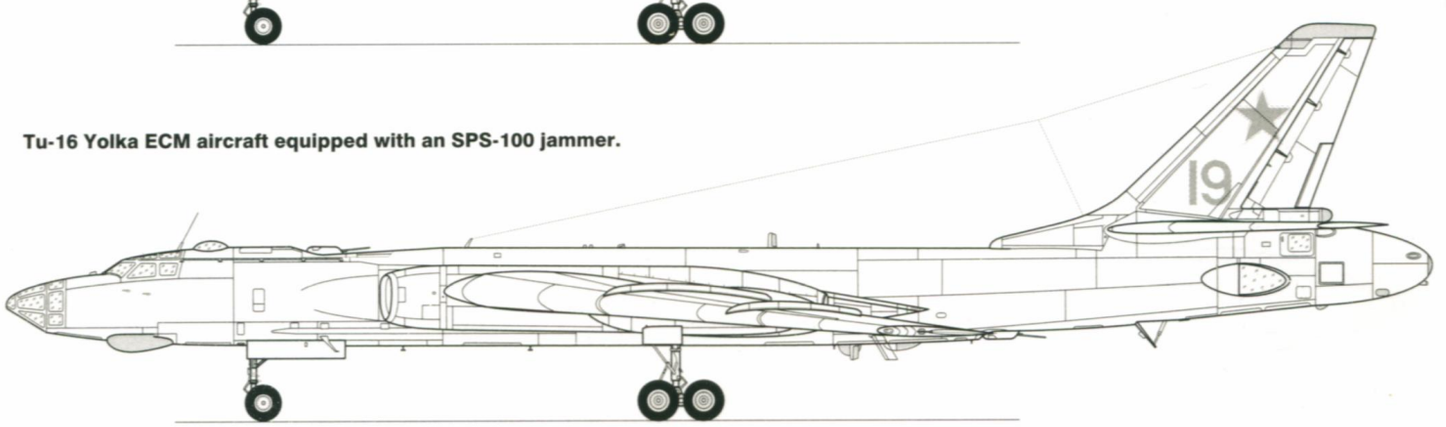
Lower view of a standard Tu-16 bomber.



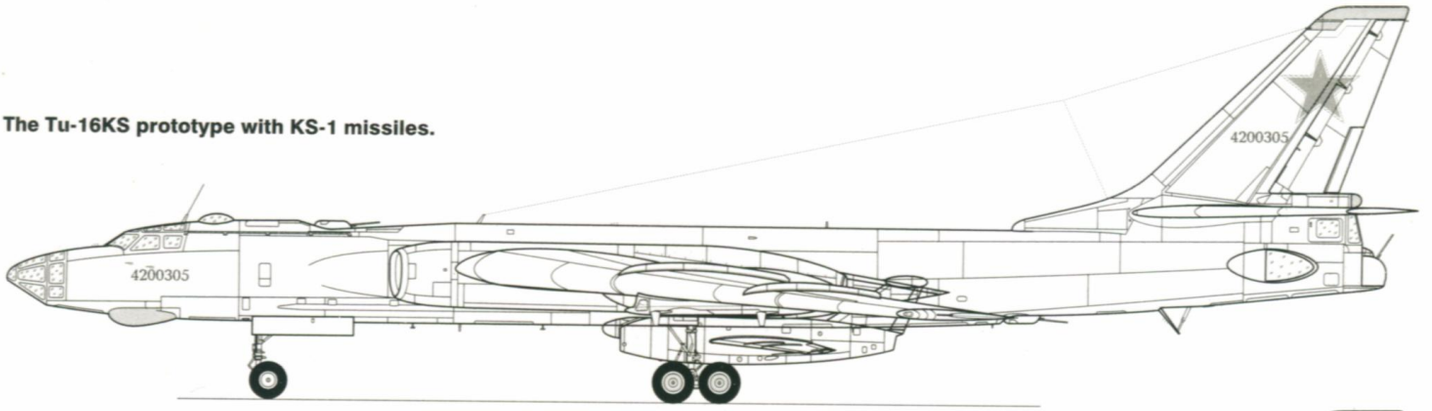
Tu-16A equipped with an SPS-100 jammer.



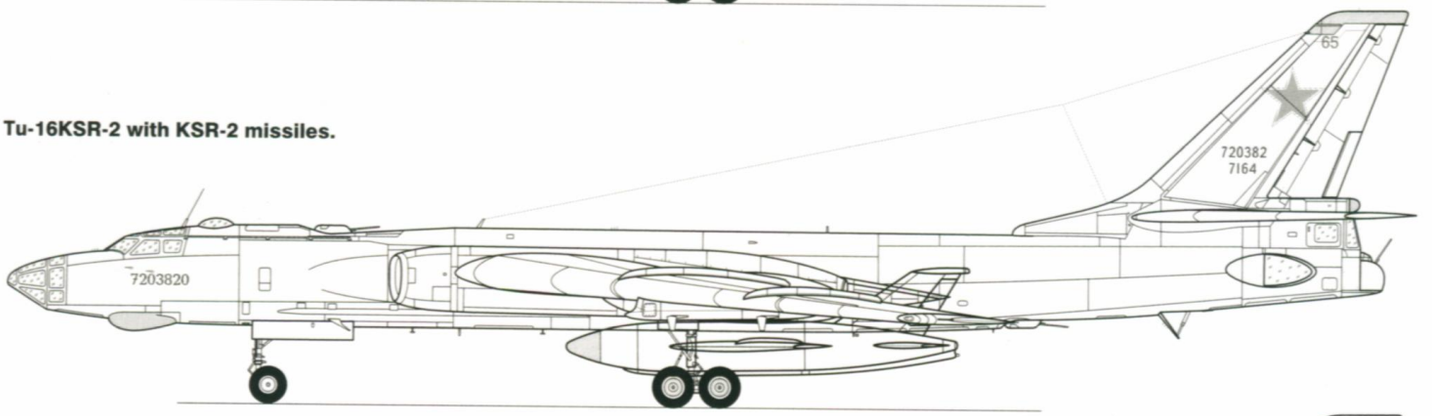
Tu-16 Yolka ECM aircraft equipped with an SPS-100 jammer.



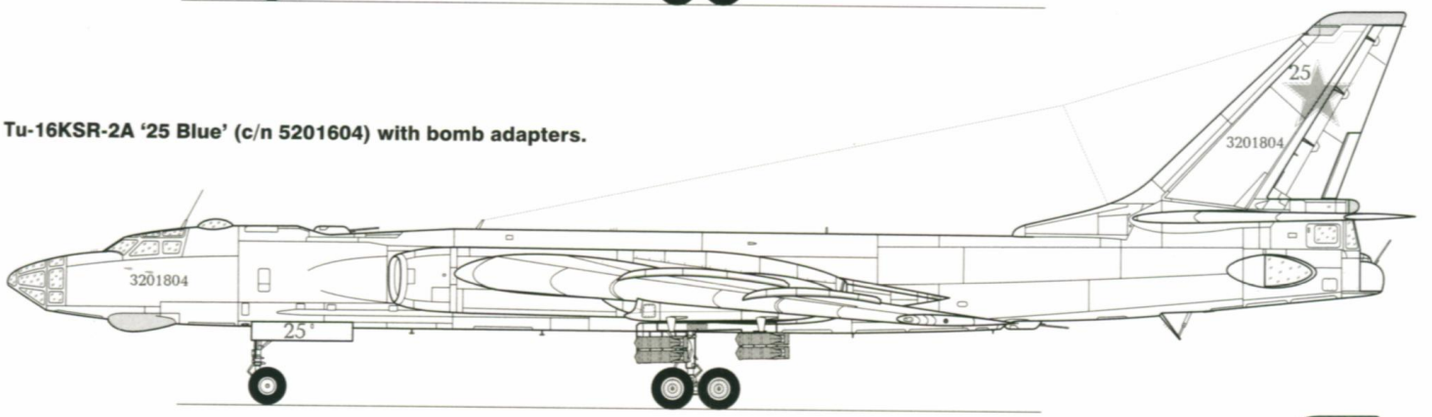
The Tu-16KS prototype with KS-1 missiles.



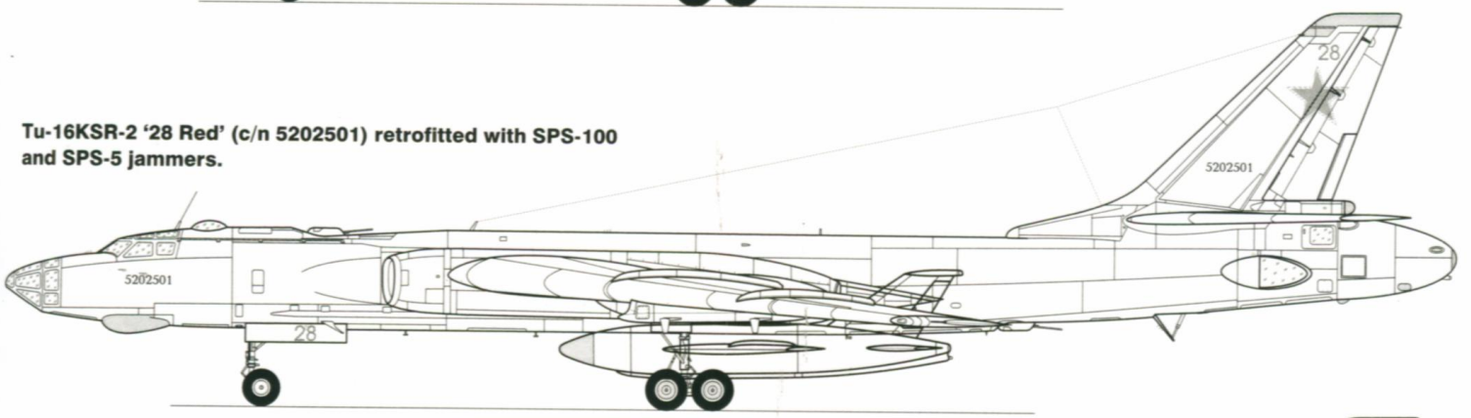
Tu-16KSR-2 with KSR-2 missiles.



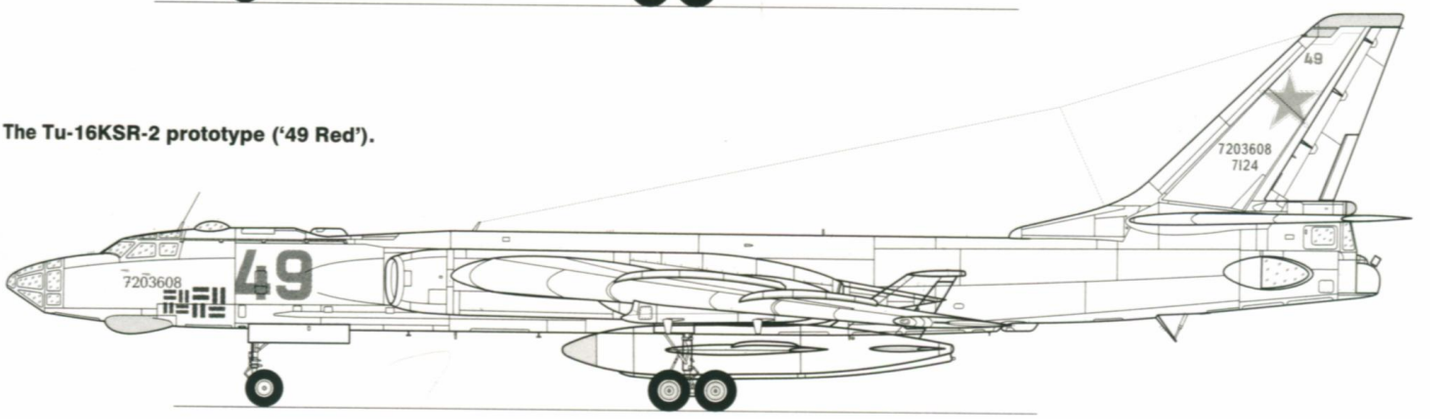
Tu-16KSR-2A '25 Blue' (c/n 5201604) with bomb adapters.



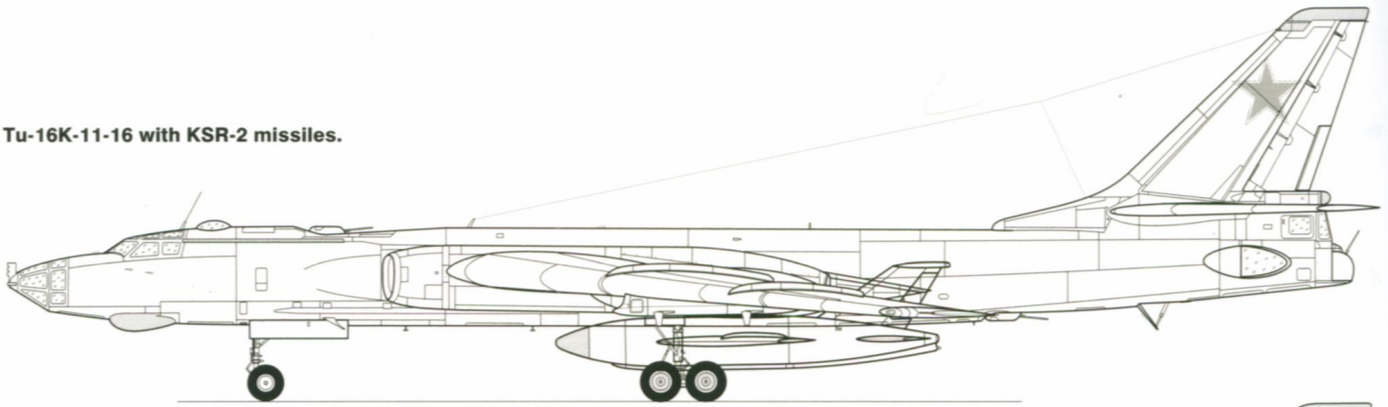
Tu-16KSR-2 '28 Red' (c/n 5202501) retrofitted with SPS-100 and SPS-5 jammers.



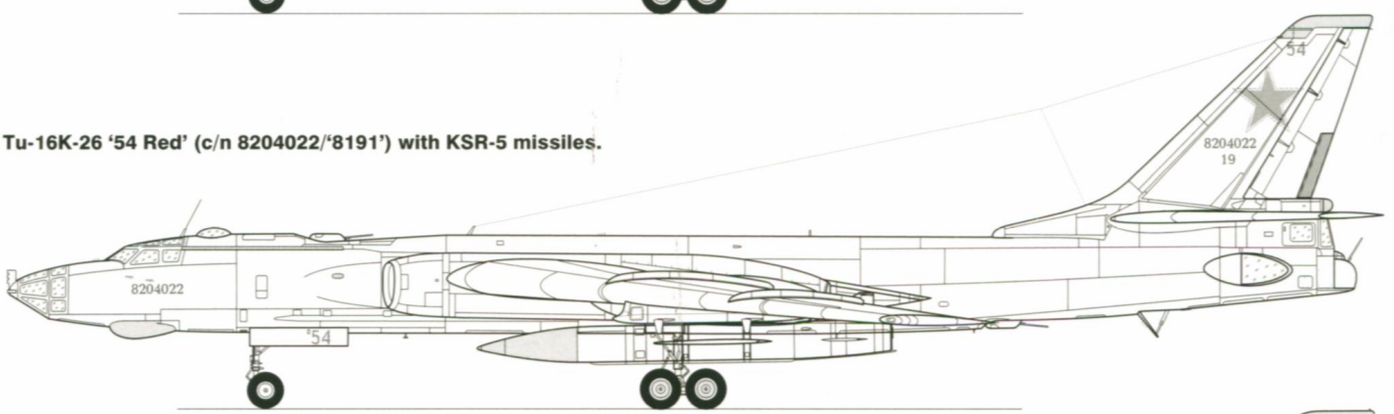
The Tu-16KSR-2 prototype ('49 Red').



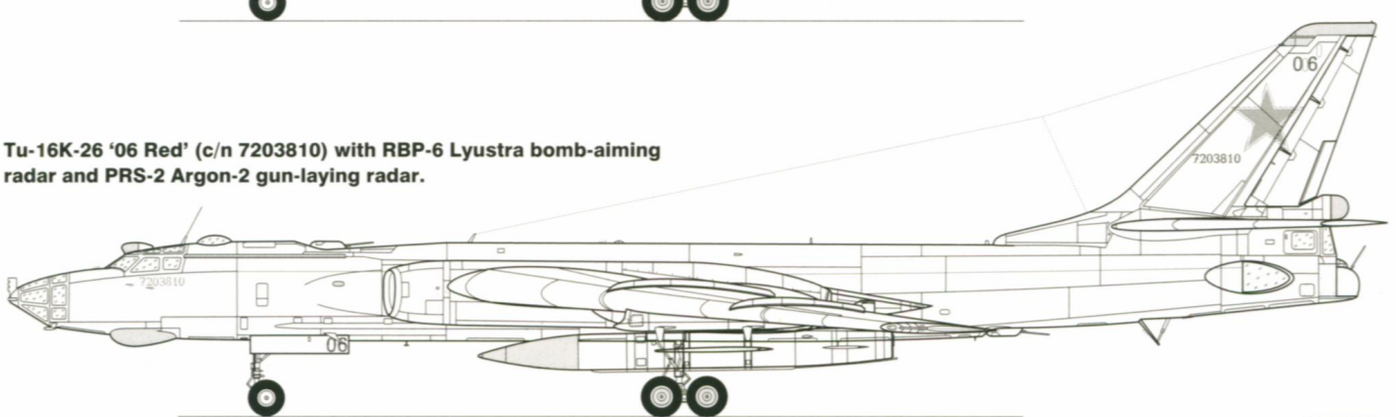
Tu-16K-11-16 with KSR-2 missiles.



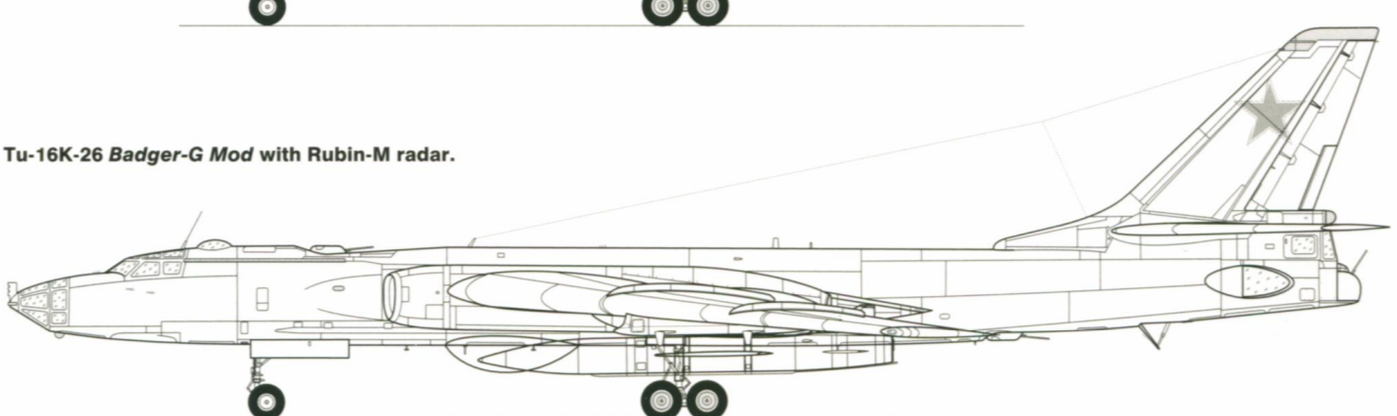
Tu-16K-26 '54 Red' (c/n 8204022/'8191') with KSR-5 missiles.



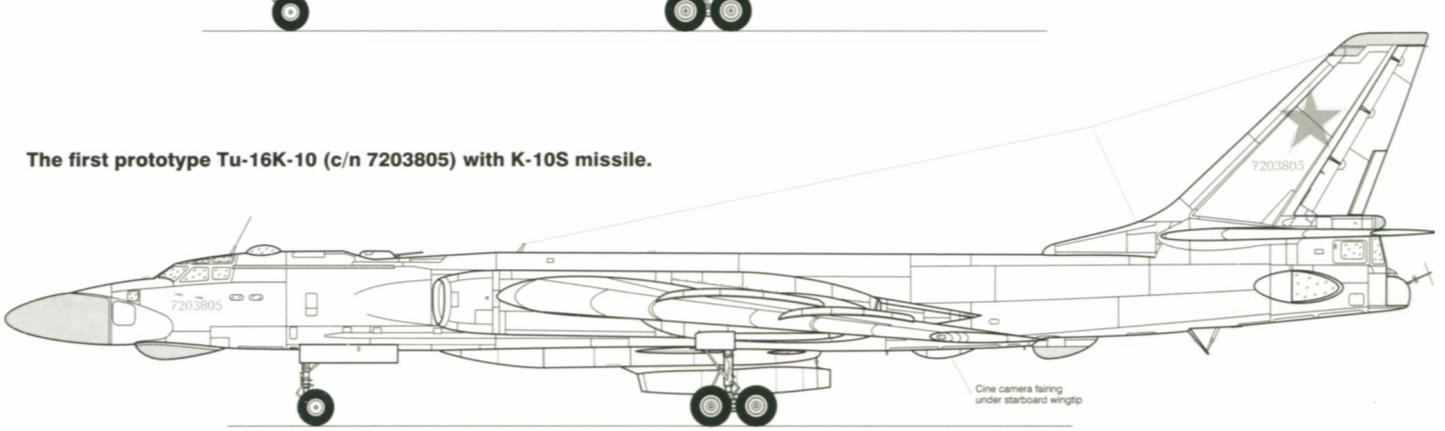
Tu-16K-26 '06 Red' (c/n 7203810) with RBP-6 Lyustra bomb-aiming radar and PRS-2 Argon-2 gun-laying radar.



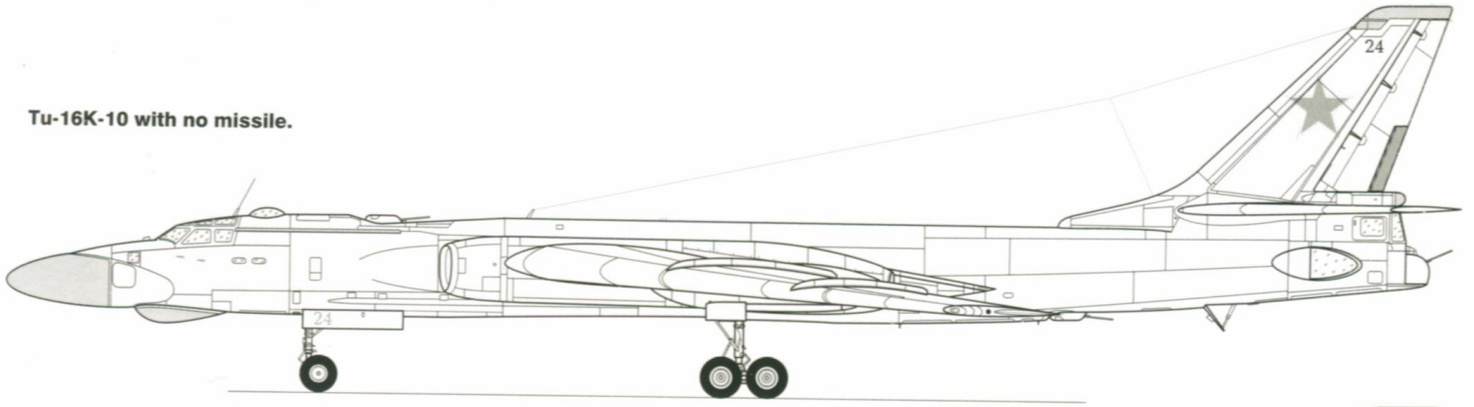
Tu-16K-26 *Badger-G Mod* with Rubin-M radar.



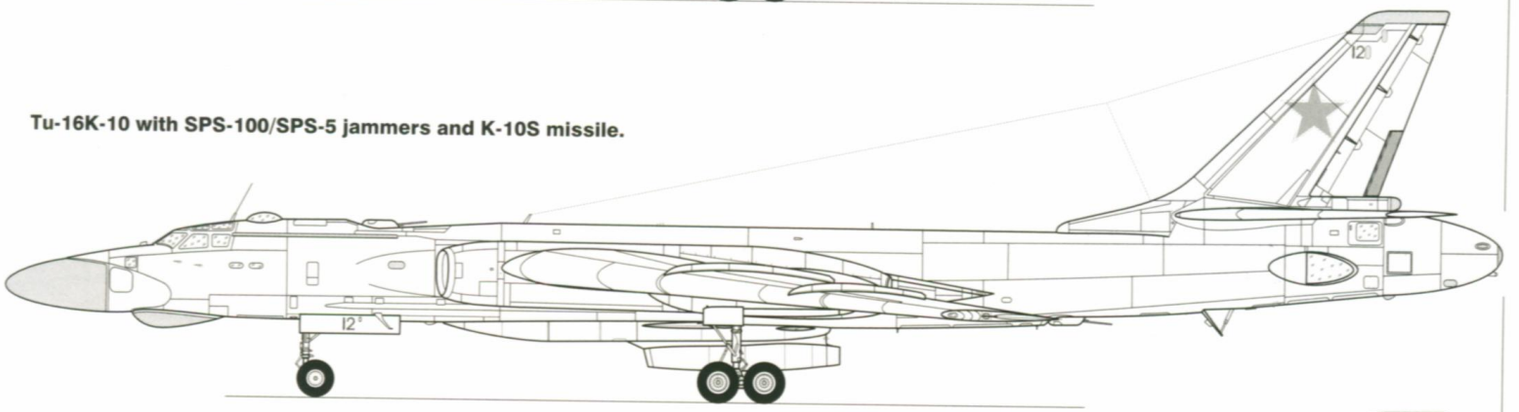
The first prototype Tu-16K-10 (c/n 7203805) with K-10S missile.



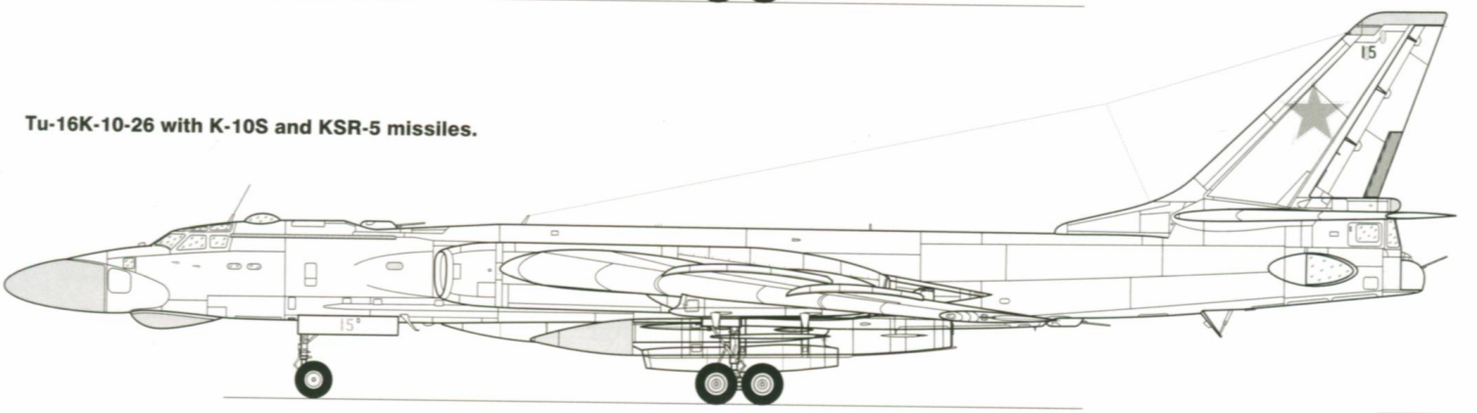
Tu-16K-10 with no missile.



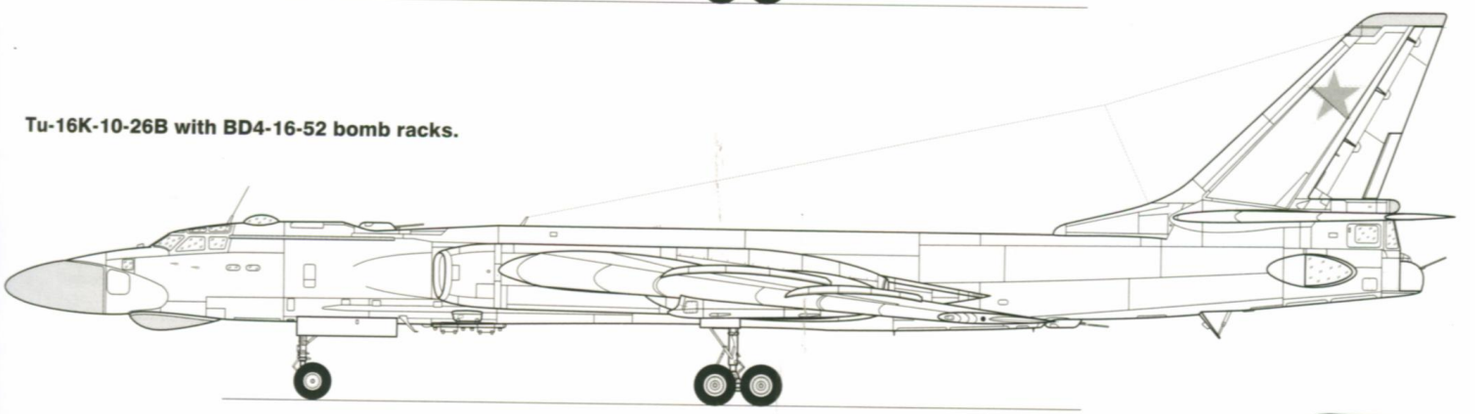
Tu-16K-10 with SPS-100/SPS-5 jammers and K-10S missile.



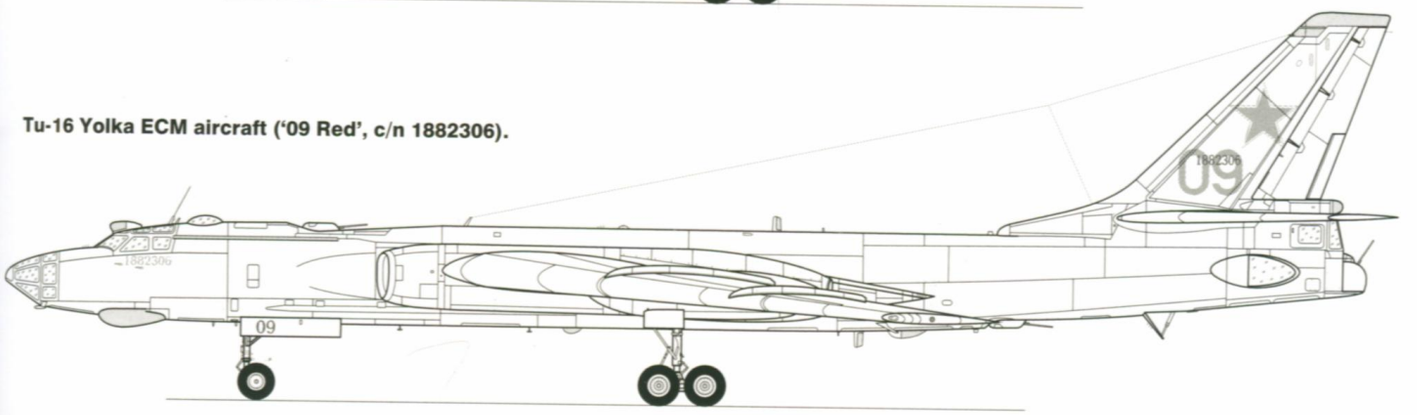
Tu-16K-10-26 with K-10S and KSR-5 missiles.



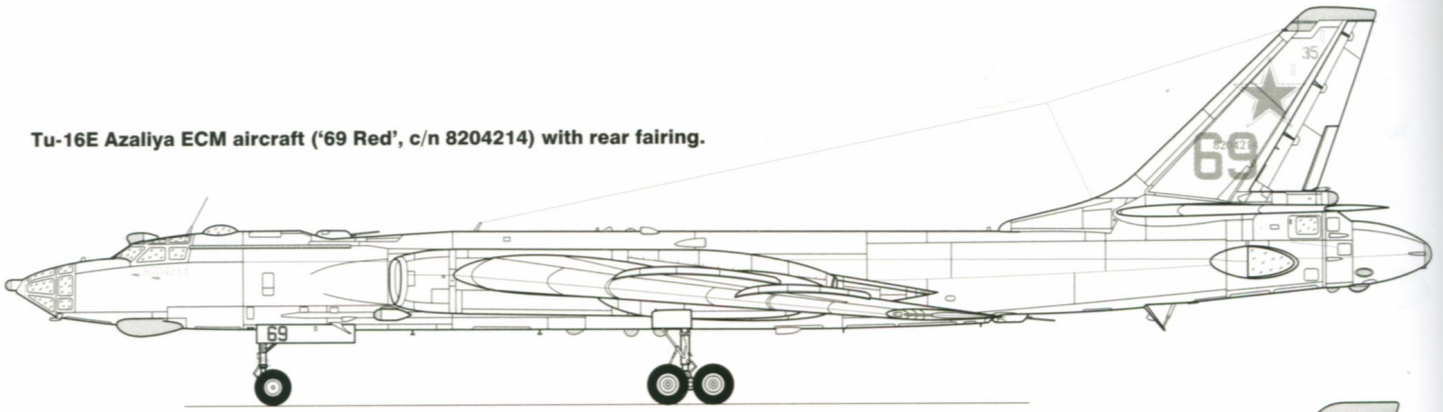
Tu-16K-10-26B with BD4-16-52 bomb racks.



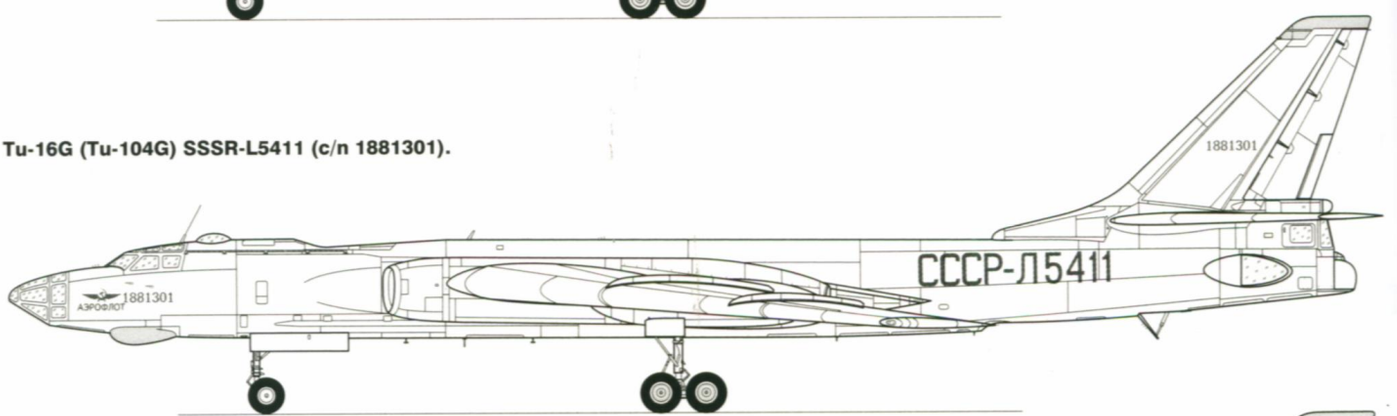
Tu-16 Yolka ECM aircraft ('09 Red', c/n 1882306).



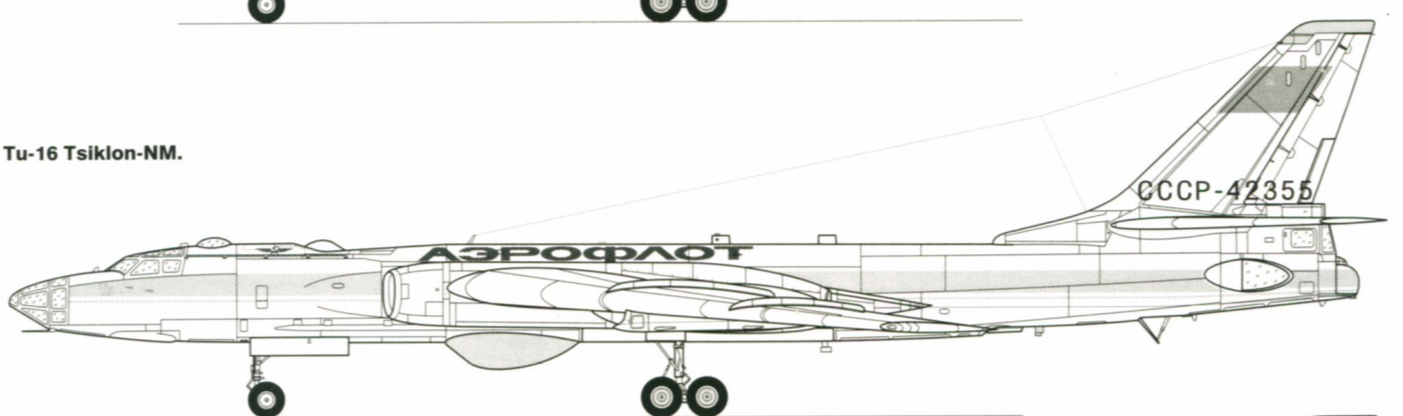
Tu-16E Azaliya ECM aircraft ('69 Red', c/n 8204214) with rear fairing.



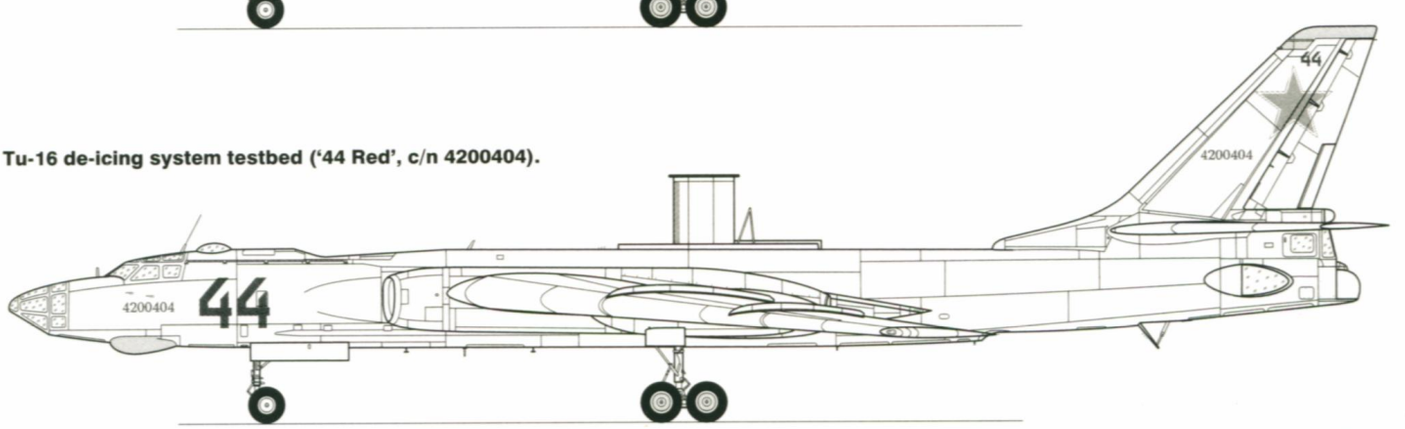
Tu-16G (Tu-104G) SSSR-L5411 (c/n 1881301).



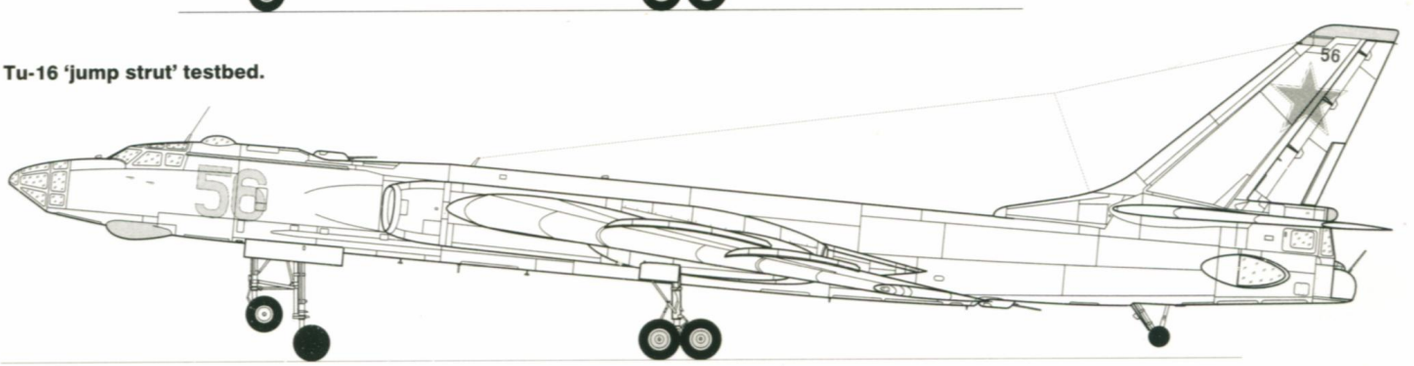
Tu-16 Tsiklon-NM.



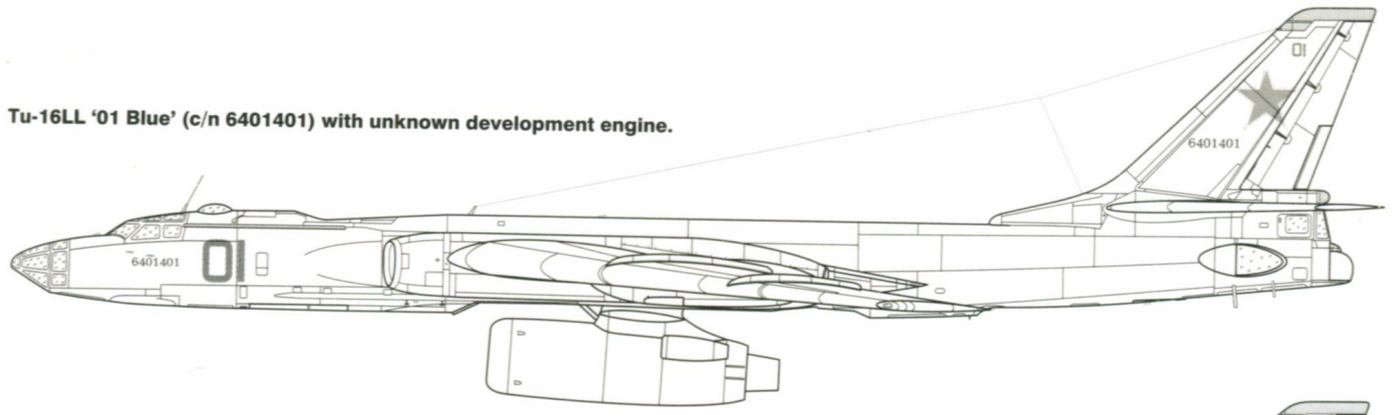
Tu-16 de-icing system testbed ('44 Red', c/n 4200404).



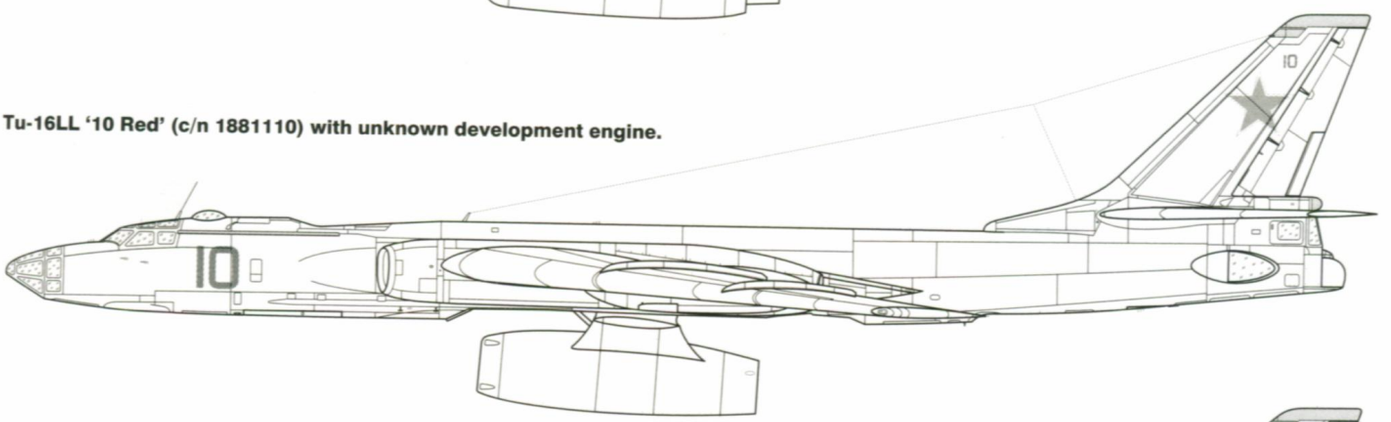
Tu-16 'jump strut' testbed.



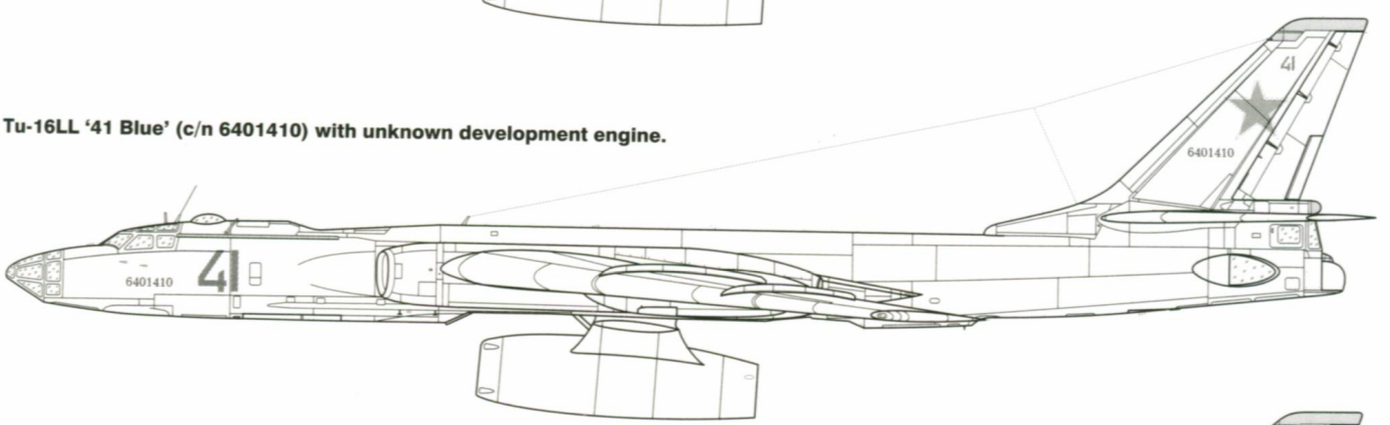
Tu-16LL '01 Blue' (c/n 6401401) with unknown development engine.



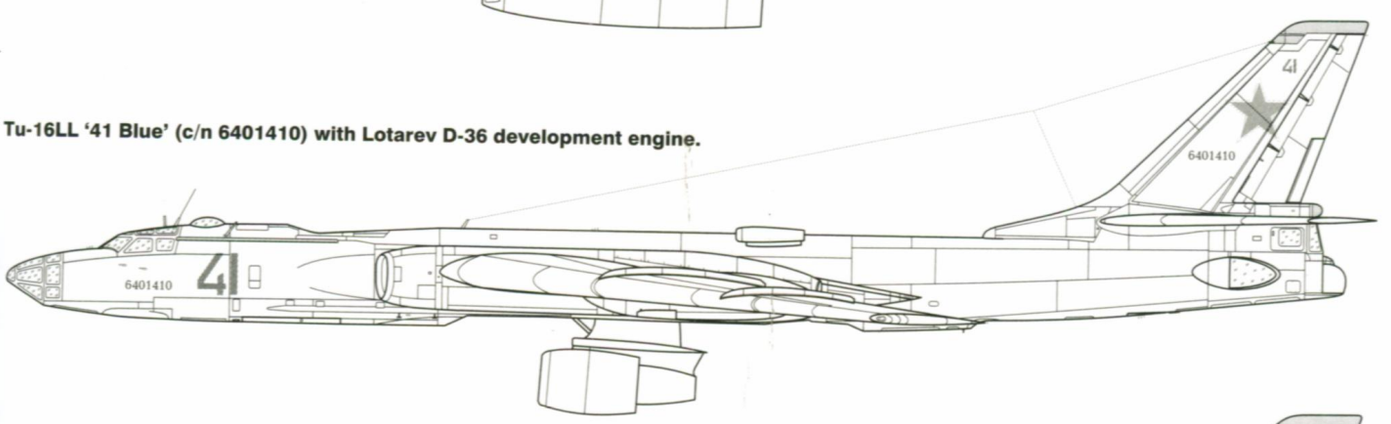
Tu-16LL '10 Red' (c/n 1881110) with unknown development engine.



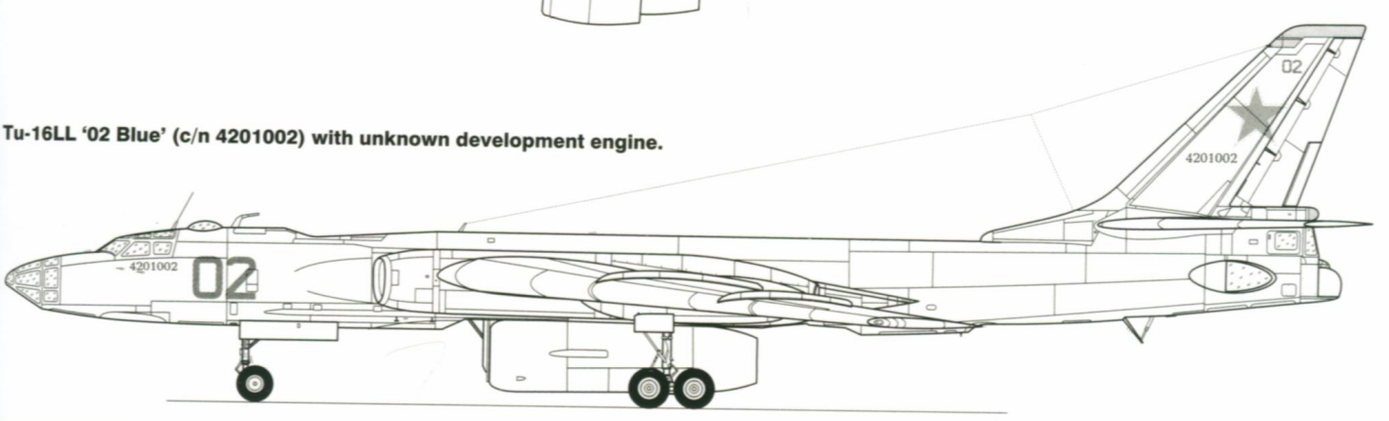
Tu-16LL '41 Blue' (c/n 6401410) with unknown development engine.



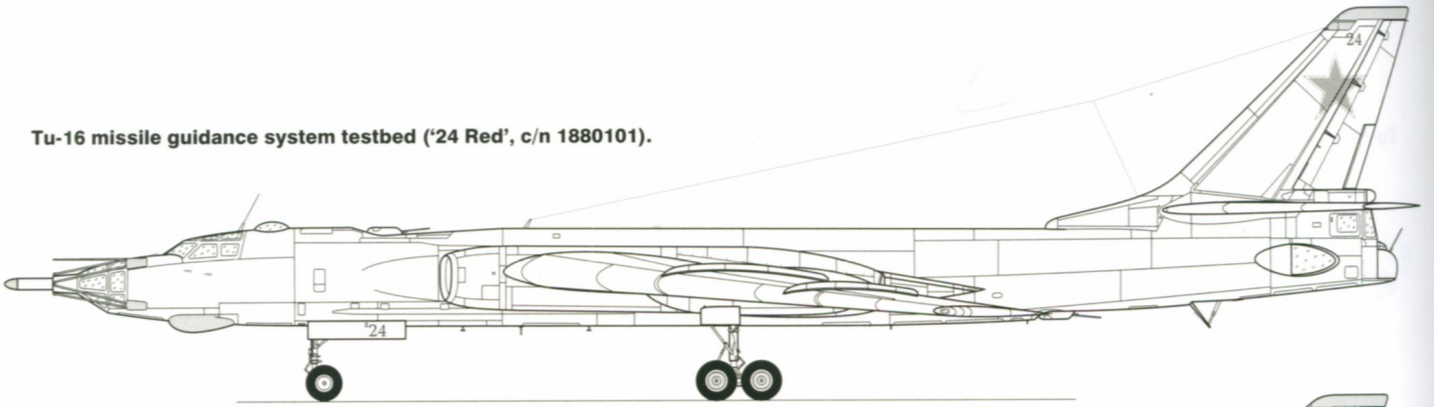
Tu-16LL '41 Blue' (c/n 6401410) with Lotarev D-36 development engine.



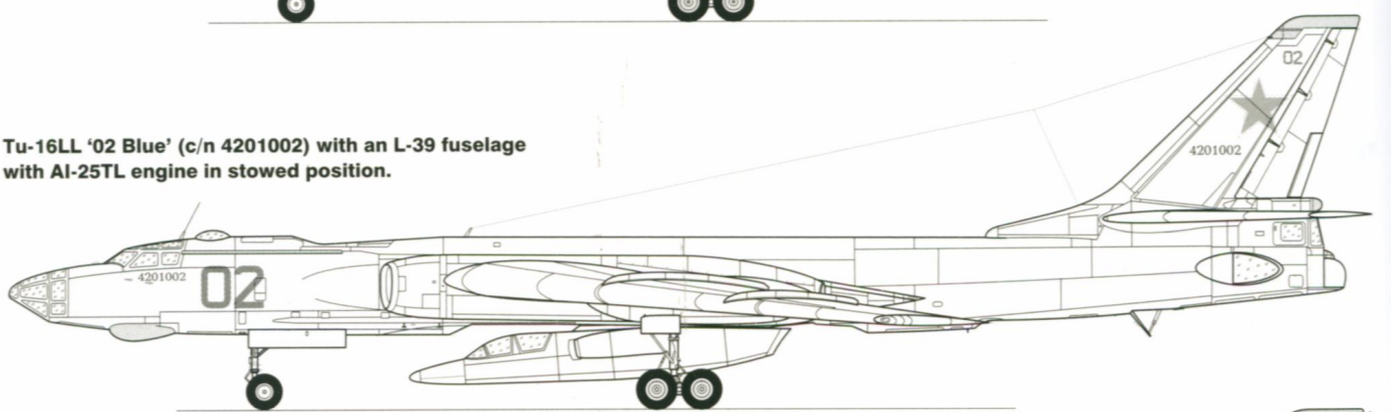
Tu-16LL '02 Blue' (c/n 4201002) with unknown development engine.



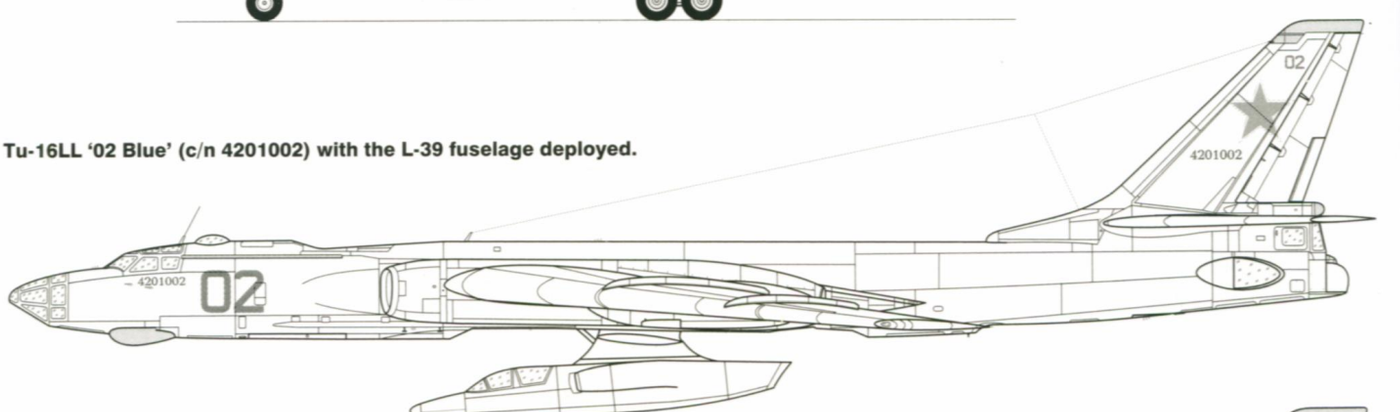
Tu-16 missile guidance system testbed ('24 Red', c/n 1880101).



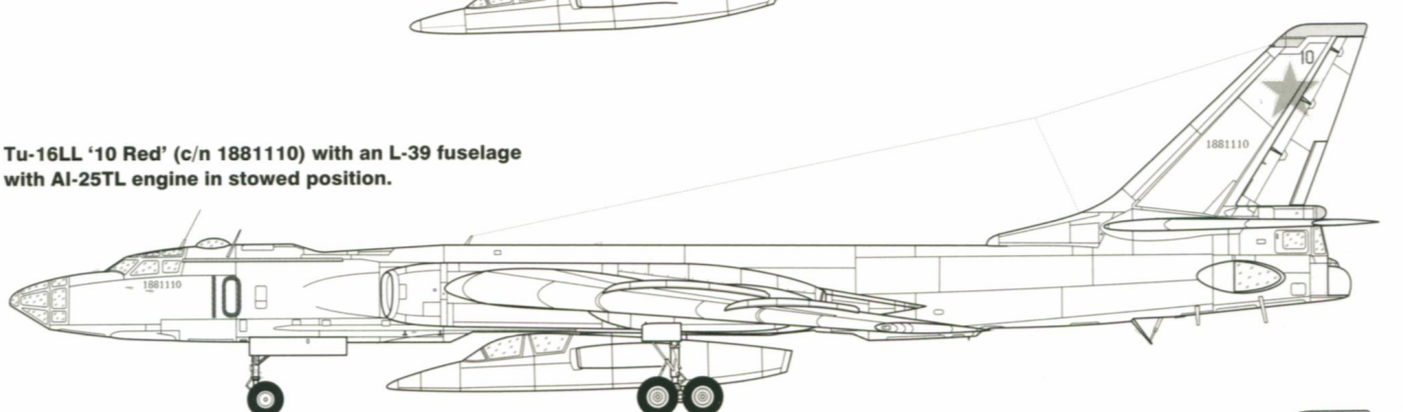
Tu-16LL '02 Blue' (c/n 4201002) with an L-39 fuselage with AI-25TL engine in stowed position.



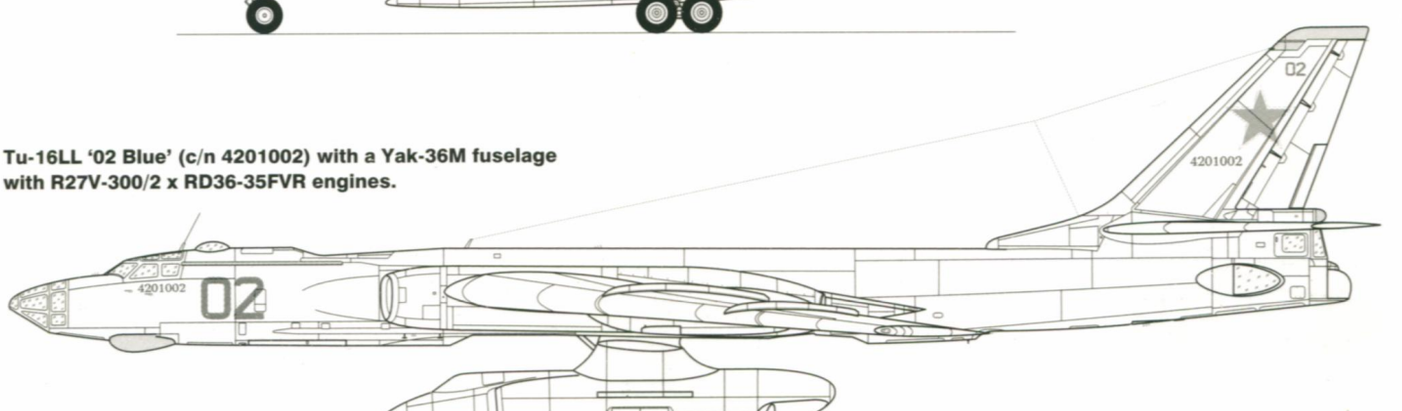
Tu-16LL '02 Blue' (c/n 4201002) with the L-39 fuselage deployed.



Tu-16LL '10 Red' (c/n 1881110) with an L-39 fuselage with AI-25TL engine in stowed position.



Tu-16LL '02 Blue' (c/n 4201002) with a Yak-36M fuselage with R27V-300/2 x RD36-35FVR engines.



The Tu-16 in Colour

Right: **Tu-16K-26 '20 Red' (c/n 7203620) equipped with protective Siren' ECM gear sits at Vladimirovka AB, the GK NII VVS facility in Akhtoobinsk in company with ECM-less sister ship '14 Red' (c/n 6401208) and a further ECM-equipped example coded '17 Red' in 1993. The nose sections have been covered with tarpaulins to protect the glazing and the dorsal turrets but the covers are 'gone with the wind' on the nearest aircraft.** Yefim Gordon

Lower right: **A Tu-16 is refuelled for a sortie by a TZ-22 articulated fuel bowser. The TZ-22 is a late 1950s vintage KrAZ-258 6x6 tractor with a 22,000-litre (4,840-Imp gal) tank semitrailer; the two-letter licence plate (10-16 ZhN) shows this is a military vehicle.** Yefim Gordon archive

Bottom right: **The Tu-16R-2 reconnaissance prototype ('50 Red', c/n 1880302) on display at the Central Russian Air Force Museum in Monino. The c/n has been obliterated by vigilant museum workers. The free-fall bombs carried by the Tu-16 are arrayed next to the aircraft, with the 9-ton (19,840-lb) FAB-9000 leftmost.** Yefim Gordon

Below: **The colour printing quality of Soviet-era magazines was horrid, but the pictures could be interesting for all that. Here the navigator/bomb-aimer of a Tu-16 wearing the standard Soviet ZSh-7B 'bone dome' helmet is pictured in his workstation, with the OPB-11R optical bombsight in front of him.** *Aviatsiya i Kosmonavtika*

A Tu-16 Yolka ECM aircraft ('23 Blue', c/n 1881605) and a Tu-16R configured with SRS-1/ SRS-4 SIGINT packs ('33 Blue', c/n 1882405) are prepared for a night sortie. No, the Tu-16 does not have airliner-style 'tail logo illumination lights' for visual identification purposes; the effect is created by floodlights on the verge of the parking area. Yefim Gordon archive

Below and Bottom: **Tu-16R '16 Red' (c/n 1883708), a GK NII VVS aircraft, pictured at Akhtoobinsk in 1993. The aircraft features additional ECM antennas in pylon-mounted pods on the sides of the nose.** Yefim Gordon

Above left and right: **More views of Tu-16R '16 Red' (c/n 1883708), showing the nose-mounted ECM antenna pods. The large mainwheel well doors are presumably opened for maintenance purposes; normally they open only when the landing gear is in transit.** Yefim Gordon

Right: **Tu-16R '12 Red' (c/n 1881809), one of several *Badgers* operated by GK NII VVS in the 1990s, retained the nose cannon and featured one ECM antenna on the port side of the nose, plus a flightdeck roof ECM blister.** Yefim Gordon

Below: **Tu-16Rs '18 Red' (c/n 1883701) and '10 Red' (c/n 1883711) were reportedly built as M-16 target drones; according to other sources, they started life as Tu-16 Yolka ECM aircraft. Here they are seen at Vladimirovka AB, Akhtoobinsk, in 1992.** Yefim Gordon

Top left and right: **Tu-16R '12 Red' (c/n 1881809) at a later date; all armament has been removed.** Yefim Gordon

Above: **A line-up of seven Tu-16s at Akhtoobinsk. Tu-16KSR-2-5 '14 Red' (c/n 6401208) in the foreground has been modified for some sort of development work, as evidenced by the non-standard aerials on the centre fuselage.** Yefim Gordon

Left: **A prototype example of the KSR-2 anti-shipping missile (c/n 4750612) under the port wing of the first operational Tu-16KSR-2s, '65 Red' (c/n 7203820/'7164'). The red colour and the chequerboard markings identify the missile as an instrumented test round. The dielectric radome has been detached, exposing the KS-PM terminal guidance radar. Note the manually driven missile lifting hoist.** Tupolev JSC

A blue-coded Tu-16K-11-16 moments before touchdown. Yefim Gordon archive

A Tu-16KSR-2 at Akhtoobinsk in 1993 with every engine cowling panel open for inspection. Yefim Gordon

Tu-16K-26 '53 Red' (c/n 4201004) at the Central Russian Air Force Museum in Monino. Unfortunately the museum people have a habit of painting the exhibits in non-authentic colours (in order to fool gullible Western intelligence agencies, no doubt); this aircraft was in reality coded '53 Blue'. Yefim Gordon

A Kazan'-built Tu-16K-10 adorned with the 'Excellent Aircraft' badge taxies at Severomorsk-1 AB near Murmansk. Yefim Gordon archive

Above: **Coded '17 Black' on the nose gear doors and '17 Red' on the tail, the Tu-16P Rezeda ECM aircraft (c/n 5202907) shows obvious signs of being converted from a Tu-16KSR-2; the missile pylons are still there.** Yefim Gordon

Bottom left: **Close-up of the tail unit and UKhO tail fairing of the Tu-16P Rezeda. Note that the dielectric cap concealing the actual emitter antenna is located at the aft extremity of the fairing, unlike some other versions where two antennas were placed laterally. The c/n and tacticai code have been all but obliterated by the elements.** Yefim Gordon

Centre left and right: **Three-quarters rear views of the Tu-16P Rezeda at Akhtoobinsk in 1993, showing the UKhO ECM fairing supplanting the tail turret. This aircraft later underwent yet another conversion, ending its days as an M-16-3 target drone.** Yefim Gordon

Bottom right: **The nose of Tu-16K-26 '20 Red' (c/n 7203620), showing the assorted electronic appendages the aircraft has gained in the course of its long service career. The nose cannon is gone and its fairing is damaged.** Yefim Gordon

Right: **Another view of Tu-16K-26 '20 Red' (c/n 7203620).** Yefim Gordon

Below: **Tu-16R '12 Red' (c/n 1881809) is readied for a test mission at Akhtoobinsk in 1992. Note the small fighter-type jet blast deflectors at the edge of the flight line.** Yefim Gordon

Bottom left and right: **The same aircraft a year later. All armament has been removed and the aircraft is earmarked for conversion as an M-16 target drone.** Yefim Gordon

Close-up of the forward fuselage of Tu-16R '12 Red' in 1992 (note that the cannon are still in place). The hardstands at Akhtoobinsk are equipped with a centralised power supply system obviating the need for ground power units, and one of the ground power outlets (the little pale green enclosure) is visible between the aircraft and the other Tu-16 parked next to it. Yefim Gordon

Tu-16R '18 Red' (c/n 1883701), pictured here at Akhtoobinsk in 1993, features unusually small ventral blister fairings of equal size. The nose-mounted ECM antenna pods have been removed, leaving only the pylons. Yefim Gordon

Tu-16R '10 Red' (c/n 1883711) in 1993; the aircraft exhibits rather more wear and tear than a year earlier and the cannon are gone. Note the two small blister fairings side by side in line with the engine nozzles (no comments please...). Yefim Gordon

All of these *Badgers* eventually ended up as drones and were shot down in the course of live weapons trials. Yefim Gordon

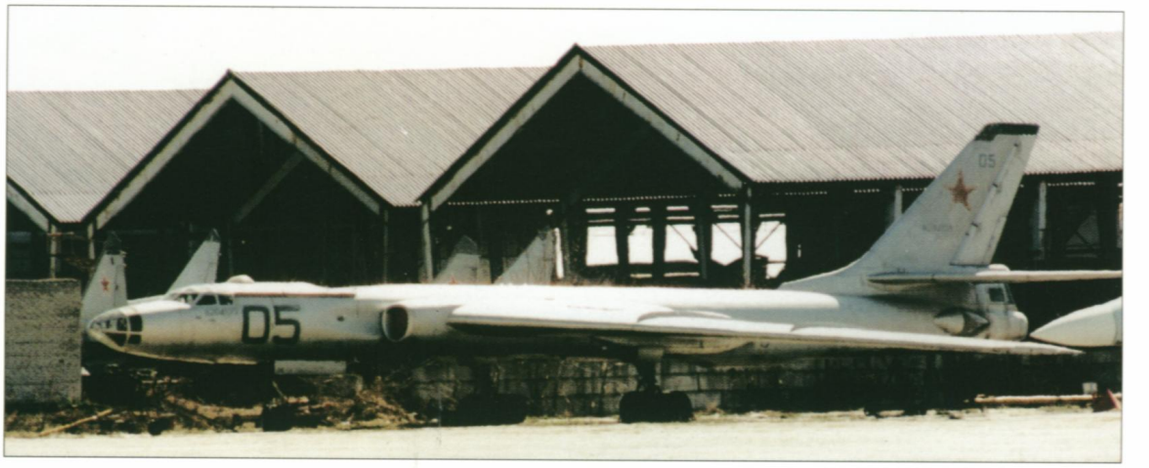
The forward fuselage of Tu-16KSR-2-5 '14 Red' (c/n 6401208); in addition to the dorsal aerials, more non-standard aerials of the same type are installed ventrally and on the sides of the extreme nose. Yefim Gordon

Tu-16 '15 Red' (c/n 5202506) was another one of GK NII VVS's testbeds, featuring highly unusual fairings under the wings which resemble missile pylons at first glance. Quite possibly it was yet another variation on the drone theme.
Yefim Gordon

Above: **Close-up of the underwing fairings on Tu-16 '15 Red' (c/n 5202506). The fairings feature hinged access panels.** Yefim Gordon

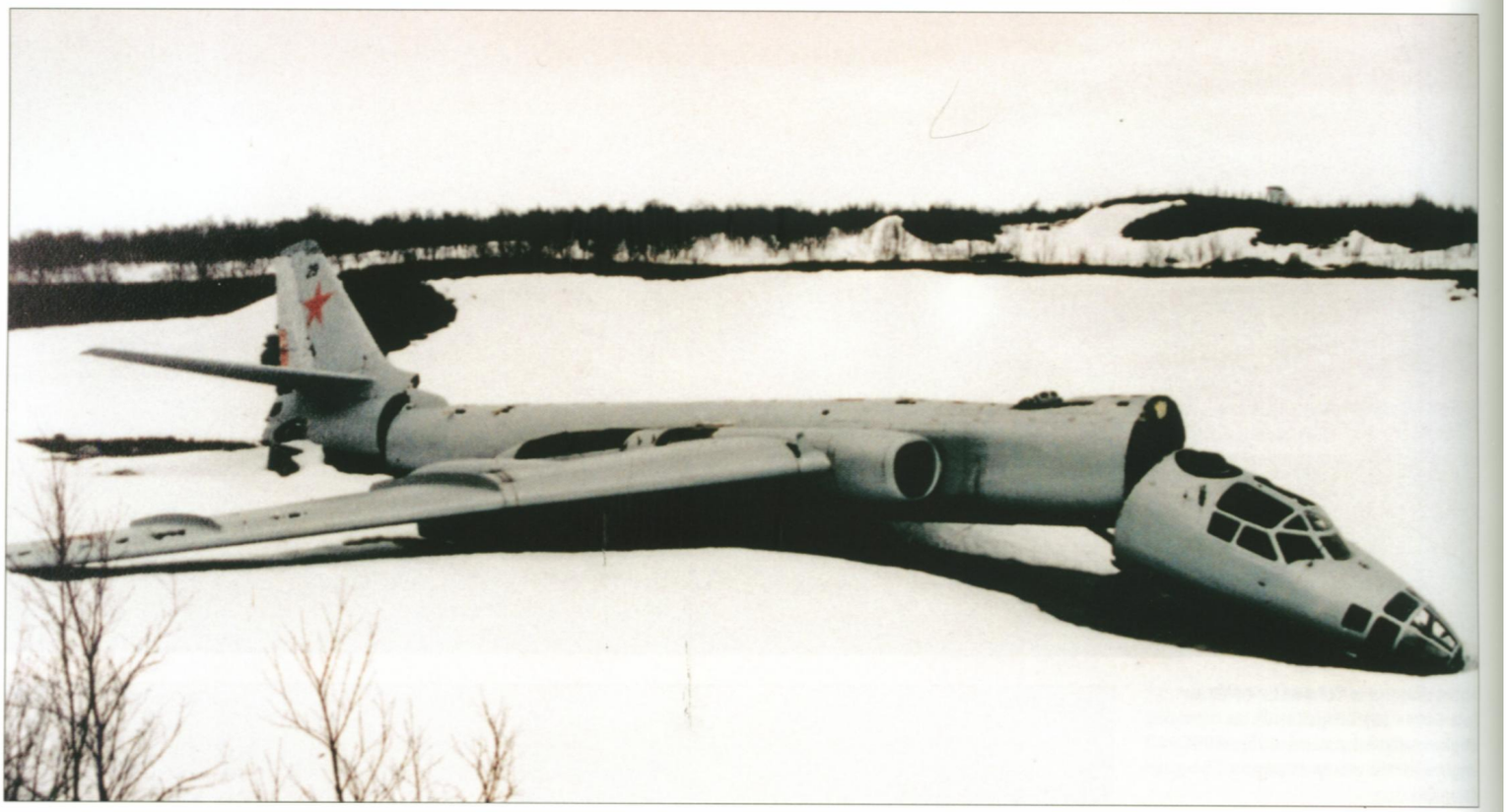
Left and below: **This M-16-2 drone at was converted from a Tu-16E Azaliya ECM aircraft with an UKhO tail fairing ('77 Red', formerly '90 Red', c/n 8204203). The characteristic forward and aft probe aerials of the radio control system are clearly visible.** Yefim Gordon

Above and right: **Tu-16LL '41 Blue' (c/n 6401410) languishes at Zhukovskiy minus development engine in the early 1990s.**
Yefim Gordon



Tu-16LL '05 Blue' (c/n 8204105) – also minus development engine and looking for employment – at Zhukovskiy in 1995.
Yefim Gordon

Tu-16 Tsiklon-NM CCCP-42355 No 1 sits forlorn at Chkalovskaya AB on 15th August 1999 during that year's Aviation Day display.
Mikhail Yevdokimov



Above and right: **A retired Tu-16 coded '29 Black' lies on the scrap dump at Ostrov AB, seat of the Russian Navy's 33rd Combat & Conversion Training Centre. The airframe has been dismembered into three large portions and awaits further demolition.** Victor Drushlyakov

Below: **Stripped of all usable items, Tu-16 '69 Red' (c/n 1883601) languishes on the scrap dump at Zhukovskiy in August 1995, with an equally dead Tu-22M2 visible beyond. Both aircraft were broken up by August 1999.** Yefim Gordon

Above: **Eight H-6As, including '30211 Blue', '30310 Blue' and '30218 Blue', bask in the sun at a Chinese airbase, with two more examples in a remote dispersal area visible beyond. The aircraft wear low-visibility national insignia.** *China Aircraft*

Right: **A squadron of H-6As taxies out during an exercise as another squadron stands by, with a power cart in front of each aircraft. The parking area in the background with individual 'parkways' makes an interesting comparison with the 'solid' apron in the foreground.**
China Aircraft

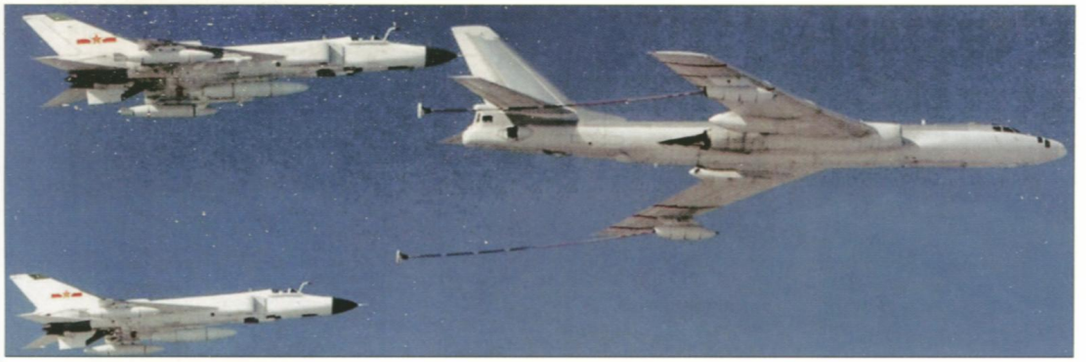
Below: **The bomb bay of an H-6A with free-fall high-explosive bombs suspended on cassette-type racks on the sidewalls.**
China Aircraft

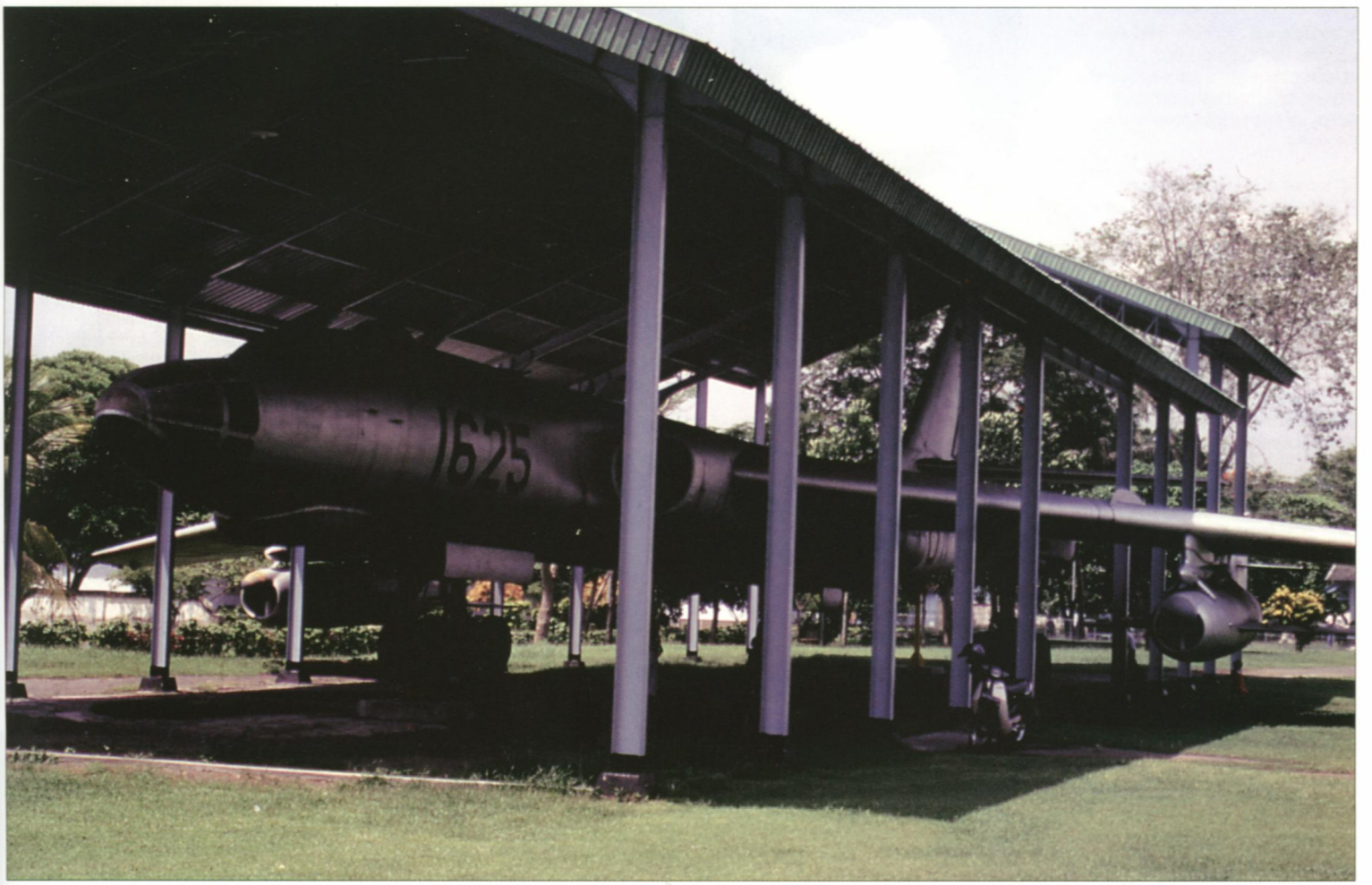
This H-6 represents an ELINT version with underwing pods and a hemispherical dielectric blister ahead of the bomb bay. The pods are slightly smaller than those of the SRS-3 equipped Tu-16R and feature a small bulge under the rear end. *China Aircraft*

A trio of H-6As dropping HE bombs during an exercise. *China Aircraft*

An almost complete H-6D in the final assembly shop of the Xian Aircraft Company, with a substantially complete HY-6 tanker and fuselage/wing subassemblies for a third H-6 in the background. The nose radome of the HY-6 is clearly visible but the navigator's station windows are papered over to prevent scratching, creating the false impression of a completely solid nose. Note how the engine housings are built integrally with the inner wings. Note also the two Y7H (An-26) transports at the far end of the building. *China Aircraft*

A brand-new H-6D in green naval camouflage on the Xian Aircraft Company apron. *China Aircraft*





Top left: **Two Shenyang J-8 IV heavy fighters, each carrying three drop tanks and two PL-2 IR-homing AAMs (a licence-built version of the Soviet K-13A, itself a reverse-engineered AIM-9 Sidewinder), formate with an HY-6 tanker.** *China Aircraft*

Top right: **Close-up of the KS-1 on the starboard pylon of Tu-16KS 'M 1625'. The number 63427 is visible on the aircraft's tail; this might be an abbreviated c/n (6203427) but, according to available sources, the 27th aircraft in Kazan'-built Batch 34 was manufactured in February 1957 and is c/n 7203427!** Peter Davison

Above: **Indonesian Air Force Tu-16KS 'M 1625' – probably the last of 25 delivered – with two KS-1 missiles sits preserved at Jakarta-Halim. A roof has been built over the aircraft to protect it from the rain.** Peter Davison

Right: **Tu-16KSR-2-11 '4407' shows the sand/green/brown camouflage applied to Egyptian Air Force *Badgers*. The camouflage pattern looks almost decorative.** RART

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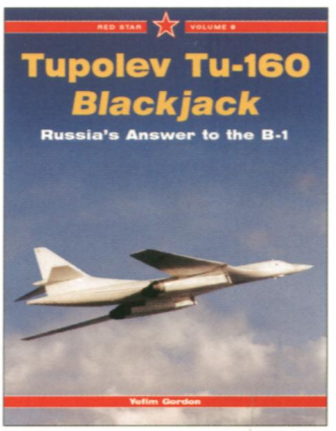
Red Star Volume 9
TUPOLEV Tu-160 BLACKJACK
Russia's Answer to the B-1

Yefim Gordon



How the Soviet Union's most potent strategic bomber was designed, built and put into service. Comparison is made between the Tu-160 and the Sukhoi T-4 ('aircraft 100', a bomber which was ahead of its time), the variable-geometry 'aircraft 200' – and the Myasishchev M-18 and M-20.

Included are copies of original factory drawings of the Tu-160, M-18, M-20 and several other intriguing projects. Richly illustrated in colour, many shots taken at Engels.

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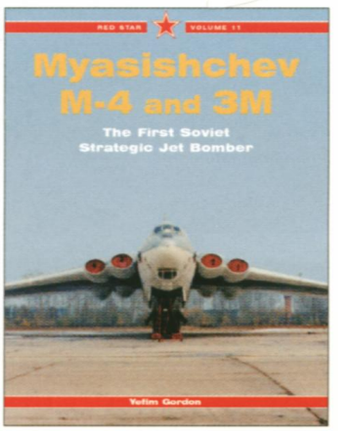
Red Star Volume 11
MYASISHCHEV M-4 and 3M
The First Soviet Strategic Jet Bomber

Yefim Gordon



The story of the Soviet Union's first intercontinental jet bomber, the Soviet answer to the Boeing B-52. The new bomber had many innovative features (including a bicycle landing gear) and was created within an unprecedentedly short period of just one year; observers were stunned when the aircraft was formally unveiled at the 1953 May Day parade. The M-4 and the much-improved 3M remained in service for 40 years.

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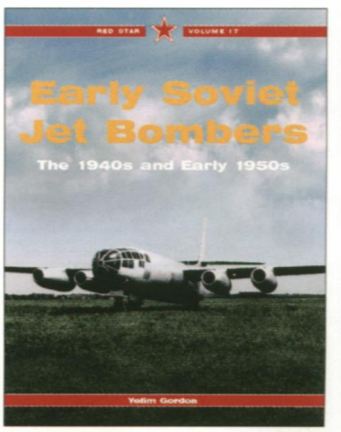
Red Star Volume 17
EARLY SOVIET JET BOMBERS
The 1940s and Early 1950s

Yefim Gordon



After WW2 the Soviet Union benefited from German technology and the men behind it. Thus, the first jet bomber to fly in the USSR was the Junkers EF131, followed by the EF140 and the equally unusual T-tailed, bicycle-gear 'aircraft 150' from Brunolf Baade. The first wholly indigenous Soviet jet bomber was the IL-22 of 1947. Other experimental Ilyushin bombers – the IL-30, IL-46 and IL-54 are described, as are the Tupolev 'aircraft 77', 'aircraft 82' and the '72/73/78' series.

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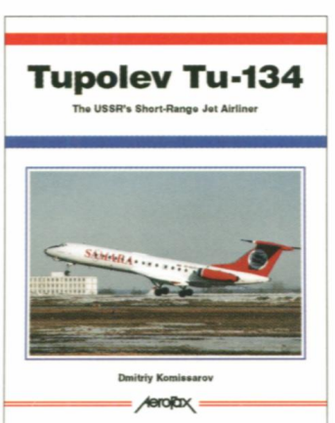
TUPOLEV Tu-134
The USSR's Short-Range Jet Airliner

Dmitriy Komissarov



The Tu-134 has seen passenger service for over 35 years in 42 countries. Its multifarious other activities include VIP transportation, support of Air Force, Army and Navy headquarters and research and test work. The type has helped train thousands of military pilots and navigators for the Soviet Air Forces' tactical and long-range bomber forces.

Compiled from first-hand Russian sources, the book gives a full account of the Tu-134 and the type's design, test and operational history.

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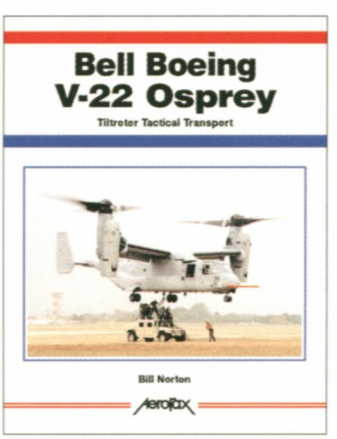
BELL BOEING V-22 OSPREY
Multi-Service Tiltrotor

Bill Norton



This technologically challenging tiltrotor project established in 1982. A transport aircraft style fuselage, able to carry 24 troops, is topped by a wing with two swivelling pods housing Rolls-Royce engines, each driving three-bladed prop-rotors. The USAF should receive the CV-22B for special missions, the US Marines the MV-22B assault transports and the Navy the HV-22B CSAR/fleet logistics version, but the program suffered setbacks, with initial operating capability now set for 2005.

Softback, 280 x 215 mm, 128 pages
174 colour, 60 b/w photos, 33 dwgs
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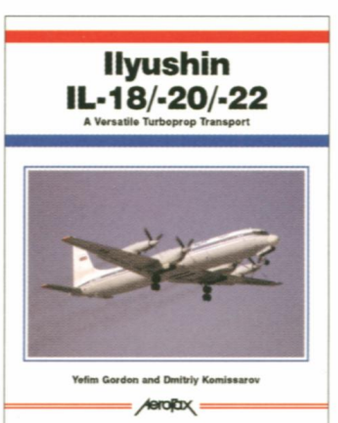
ILYUSHIN IL-18/20/22
A Versatile Turboprop Transport

Yefim Gordon and Dmitriy Komissarov



The IL-18 four-turboprop airliner first flew in 1957 and was supplied to many 'friendly nations' in Eastern Europe, Asia, Africa, Middle East and the Caribbean. Its uses included passenger and cargo, VIP transportation, support of Antarctic research stations, electronic espionage and various research programmes. All versions are described, as are many test and development aircraft, the IL-20M ELINT, IL-20RT space tracker, IL-22 airborne command post, IL-24N for ice reconnaissance and IL-38 ASW aircraft.

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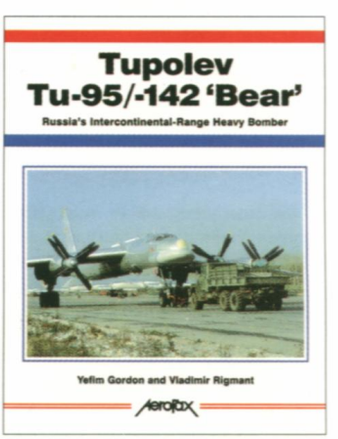
TUPOLEV Tu-95/Tu-142 'BEAR'

Yefim Gordon and Vladimir Rigmant



During the 'Cold War' Tupolev's Tu-95 'Bear' strategic bomber provided an awe-some spectacle. It was the mainstay of the USSR's strike force, a reliable and adaptable weapons platform. Additional roles included electronic/photographic reconnaissance and maritime patrol, AEW and command and control.

The author has had unparalleled access to the Tupolev OKB archives, taking the lid off a story previously full of speculation to produce the most comprehensive study to date.

Softback, 280 x 216 mm, 128 pages
236 b/w, 24 col photos, 12 diagrams
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Top: **This Tu-16P Rezeda ECM aircraft (c/n 5202907) shows obvious signs of being converted from a Tu-16KSR-2; the missile pylons are still there.** Yefim Gordon

Above: **Tu-16LL '01 Blue' (c/n 6401401) at Zhukovskiy in 1991.** Yefim Gordon

Front cover illustration:
'06 Red', a Soviet Air Force Tu-16KS, flies with a single KS-1 missile on the port pylon. The bright red colour of the missile identifies it as an inert round. *Aviatsiya i Kosmonavtika*

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